SCIENTIFIC AMERICAN

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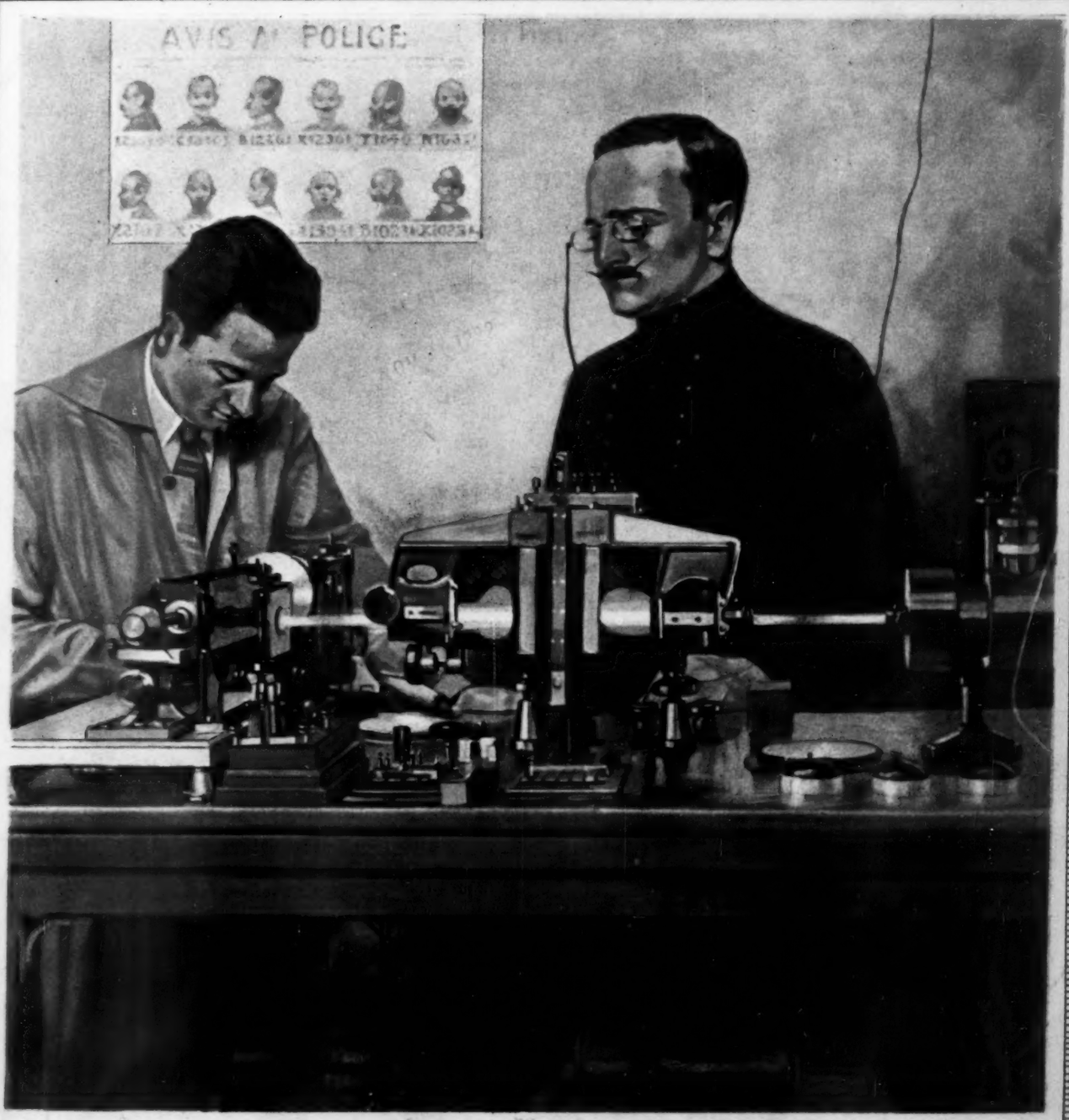

RECEIVING FINGER-PRINT RECORDS VIA RADIO FOR POLICE IDENTIFICATION PURPOSES.—[See page 386]

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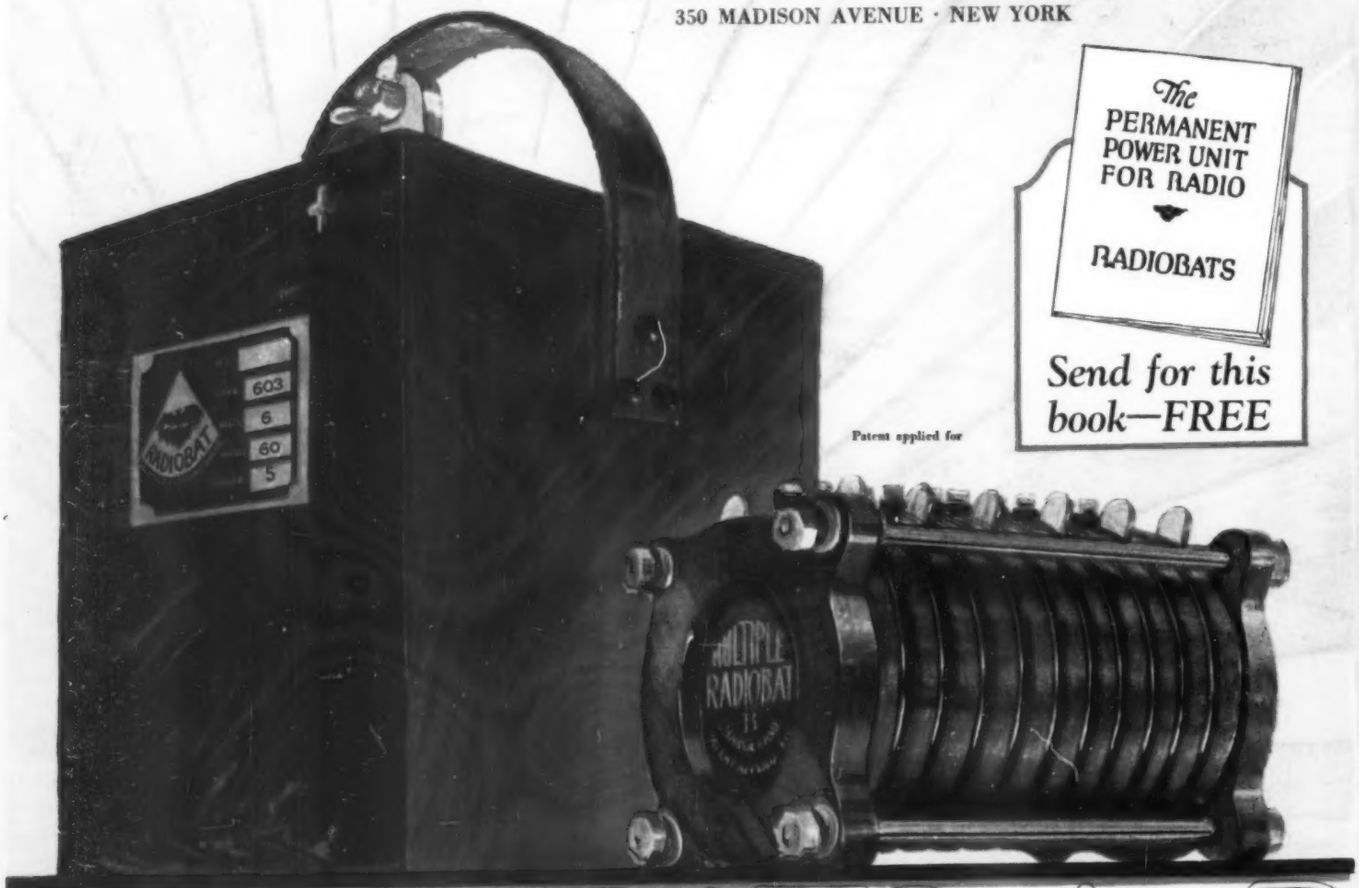

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With the Editors

THE most important item in the present issue is, of course, the announcement on page 389. We have deliberately avoided the use of the word "prize" in this connection because we do not want to regard the affair as a contest. We offer the money to the first successful medium simply as an inducement to mediums to come forward and cooperate with us in an attempt to get at the facts of mediumship. We should be pleased to receive preliminary assurances from any medium that he or she will thus come forward; such assurance, of course, to depend in some measure upon the acceptability of our final conditions.

IN the means which we have adopted to put ourselves in first-hand contact with psychic phenomena for future discussion in our pages we are particularly anxious not to have it appear that we are blundering into a field that is already occupied, or stealing anybody's thunder. It is perhaps true that there is a sufficiency of psychic investigation going on today—if it were all well done and adequately reported to the public. Unfortunately, much of it is, in its unscientific character, about on a par with the McKenzie report; and that which is of real value is far too often buried in inaccessible volumes where the general public by no chance ever comes on it. Too, there is undoubtedly the feeling that *all* investigating bodies are predisposed for or against. We believe that the membership of our committee will be such as to guard against this; and we believe that our own standing is sufficiently that of the impartial critic to add more assurance. In short, we hope to turn out some findings which shall combine competence, authority, disinterestedness and circulation as these individual features may have existed in individual reports, but as they have never yet been brought together into a single document on psychic investigation. We hope to have the cooperation of existing agencies of investigation to an extent which shall clear us of any suggesting that we are intruding upon a field which is really theirs; and which will make it plain that we are entering that field simply because we consider that we possess certain advantages for work therein which no existing agency enjoys.

CONSTANTLY we are faced with the old, old question "Does the world really move forward, or does it just mill around in the same old place?" Sometimes we even go so far as to admit a third alternative, addressed to the possibility that we are actually drifting backward! The answer to this question depends a good deal upon the direction in which one makes his survey. Just as a runner cannot proceed both north and south at once, so the world cannot move forward along all lines at once. When we survey the upset condition of industry, finance, politics in its smaller aspects and in its international forms which bear the more polite title of statesmanship or diplomacy, we find today many things at pretty low ebb. But in our own particular department of human affairs, invention and research—applied and pure science, in other words—we are really going forward at a dizzy pace. In every direction this department is crammed with new departures. Just to confine ourselves to the field of invention as represented in this issue, we find that whether we look at locomotives, fire-boats, airplanes, radio or what not, we are doing new things and doing old things in new ways. What more daring concept could well be put forward in the mere mechanical application of known principles than the control of all sorts of complicated industrial processes by a simple roll of perforated paper? Who would have prophesied, a few years ago, any of the numerous applications of the microscope that Dr. Hausman's ingenuity has found out? And when it comes to pure science—one's breath is lost in merely trying to keep up with the procession, and one has none left to expend in wonderment.

THERE are styles in conversation as well as in dress. Current fashions in polite discourse—and presumably in the thought that underlies such discourse—run toward psychology. Psychology is in: distinctly in. The great vogue enjoyed by the magazine advertiser who offers a simple course in self-knowledge which shall make a finished master of men out of any clod-hopper in six weeks is about as impressive an example of this as could well be cited. Auto-suggestion, faith cures, specific tests of ability, are all the rage. With Freud and Hermione the inimitable on one side, and intelligence tests for college entrance along with the role played by the psychologist in psychic investigation on the other, it becomes clear that this science covers the whole gamut of current affairs from the sublime to the ridiculous, from the extremes of theory to those of practice. We have asked Mr. Cary to write about Dr. Seashore's specific tests for musical ability, not so much because these are in themselves an extremely interesting development, but because they are a very significant part of the trend of current science. If it had been possible for Dr. Seashore to have done this work ten years ago, it would have stood as an altogether extraordinary isolated phenomenon; now it is wholly in keeping with the trend of events.

JUST a word about the interesting things in our next issue. We shall have an account of a new type of vacuum tube which is of large moment in general electrical work as well as in the rather special radio application. There will be the story of illuminating gas: how it is made and the place it holds. An extraordinary type of bearing block, developed in England and greatly reducing friction losses in machinery of numerous types, will be described and illustrated. The biological and economic aspects of the minute living organisms of lakes and oceans will be discussed. The Southern farmers, having about made up their minds that they can't get away from the boll weevil, are now busy with Federal aid devising ways to get along with him; and the story of this will be told. The second and final installment of "Inventor vs. Forger" will explain the successes and the shortcomings of the mechanical check protectors which have been put out in the effort to prevent raising. The case of liquid fuel as against solid will get further attention, and the restrictions of the former medium as regards household use will be made more clear than we had space to make them in November. An account of just what Professor Steinach is able to do and what he is not able to do in the conquest of old age will appear. These are but a few of the many interesting things that will come along in January—or, if some of them get crowded out, in later issues.

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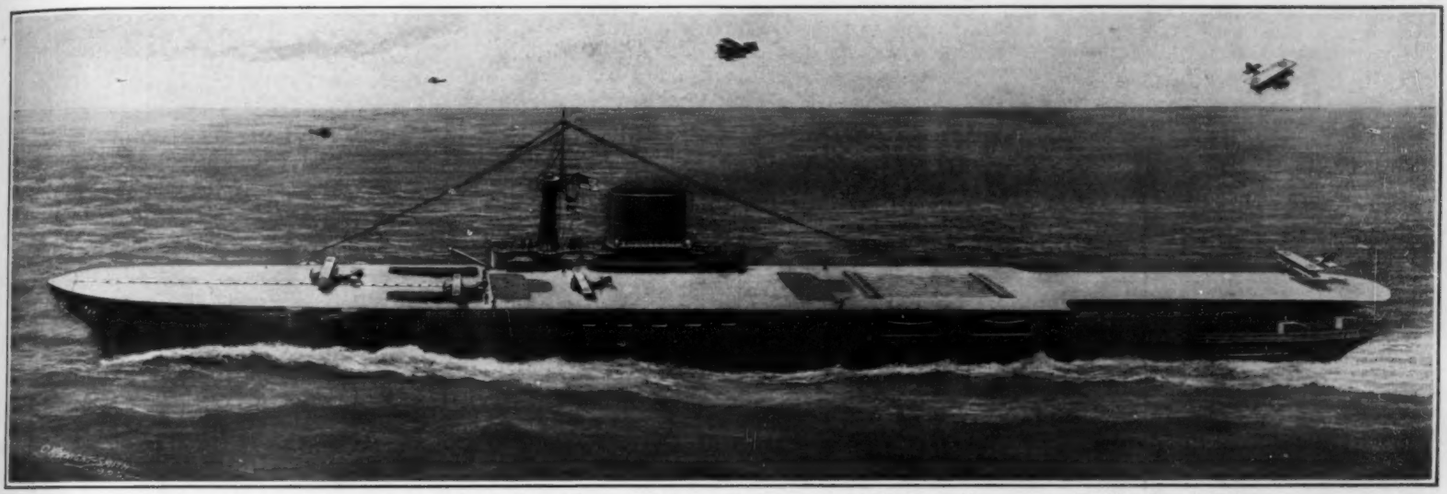
SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, DECEMBER, 1922



Airplane carrier "Lexington." Length, 874 feet. Beam, 104 feet. Displacement, 35,000 tons. Horsepower, 33,000. Speed, 22 knots

The Largest Cruising Airdrome

WHEN the Disarmament Conference met a year ago in Washington, six battle cruisers, which would have been the largest and fastest of their type afloat, were under construction in various yards, private and governmental, throughout the United States. The keels of all six had been laid and some of them considerably advanced in construction, the degree of completion varying from 3 per cent to about 30 per cent. The amended designs in accordance with which they were being built, called for a length over all of 874 feet, a beam of about 104 feet, a draft of 31 feet, and a displacement of 43,500 tons. They were to mount eight 50-calibre, 16-inch guns in the main battery and sixteen 6-inch guns in the anti-torpedo battery. The most remarkable feature in these ships was the motive power, which was to employ the electric drive and develop 180,000 horsepower upon four shafts, and give these ships a speed of 33¼ knots. Built as thus designed, they would have been exceedingly handsome vessels, with two cage masts between which there would have been two large elliptical funnels.

It will be remembered that the most sweeping reduction made at the conference occurred among the capital ships—battleships and battle cruisers—which were under construction when the conference convened. Among the ships that were at first eliminated were the six battle cruisers; but, subsequently, among the modifications which were made in the first plans, was one permitting both the United States and Japan each to complete two of their battle cruisers as aircraft carriers. A limitation of a maximum displacement of 35,000 tons was placed on the size of such vessels; a maximum total of 70,000 tons being allowed to any navy for vessels of this type.

Our naval authorities decided to complete as aircraft carriers the two battle cruisers which were most advanced in construction. These were the "Lexington," building at the yards of the Bethlehem Shipbuilding Corporation, at Fore River, Mass., and the "Saratoga," which was being built by the New York Shipbuilding Corporation at Camden, N. J., the "Lexington" being at that time 26.7 per cent completed, and the "Saratoga" 29.4 per cent.

Now to those of us who have studied the drawings of these battle cruisers, which were published in the SCIENTIFIC AMERICAN from time to time, it will be evident that the main hull structure will not be very greatly altered, at least, in its outboard profile. There will be no change in the form of the hull below water, and the changes in the upper structure will be such as are necessitated by the new positions of the 6-inch gun battery, and the provision of the necessary airports, and the openings for the stowage of boats.

The *sine qua non* of an aircraft carrier is the provision of a broad and long flush deck—the longer and the broader the better—extending from stem to stern, and from side to side, with the least possible amount of obstruction. Consequently, in looking at the "Lexington" in its reconstructed form we see that the four turrets with their eight 16-inch guns have been swept away, together with the whole of the superstructure between them. The two centrally placed masts and the two funnels have also disappeared. In their place we see a single cage mast with abaft of it a huge elliptical funnel, erected on the starboard side of the ship and a little forward of her mid-length. Forward of the military mast is a low conning tower between which and the base of the mast is a chart room. Aft of the smokestack is a deck house for the use of the navigating officers, the officers of the watch, etc. At the forward and after end of these structures is a single derrick for hoisting aircraft from the water. Above the conning tower is a range-finder, and a fore and aft bridge extends from the conning tower around the mast to the after end of the smokestack. A ladder leads from this bridge up to a platform which encircles the smokestack, and carries at each of its corners a high-powered searchlight. The top of the cage mast finishes in an enclosed fire-control platform, and to the rear of this is erected a steel pole mast from which the wireless antennae extend forward and aft, down to suitable connections at the deck. It should be noted that the smokestack serves to enclose five separate uptakes from the boiler rooms.

The after half of the upper deck is used as a flying-on deck for the landing of airplanes, and to assist in bringing them to a standstill after landing at the stern and running forward for some 200 feet, they pass on to a net device, which acts as a powerful brake, and stops them quickly but without injury to the machines. Just ahead of the net is a large hatch and there is another one abreast of the conning tower. Through these the airplanes are passed up or down from the flying-deck to the hangar deck below. Just ahead of the forward hatch are two of the new compressed-air catapults, which were designed and developed last year at the League Island Navy Yard. Each of these is carried on a turntable, and they are capable of being trained through a wide arc forward of the beam. They are so constructed that, by the time the airplane leaves the catapult, it has a velocity sufficient for flight. Arranged centrally between the catapults, and extending to the bow of the ship, is an endless chain, or wire rope, by means of which also an airplane may be launched; but the details of this mechanism will not for the present be available for the public. Below the flying-deck is a hangar, which is of sufficient size for the stowage of a large fleet of airplanes. On this deck are also various machine shops, where thorough repairs can be made to disabled machines. The vessel is also fully equipped with fuel tanks and the various stores which are necessary to maintain the airplane fleet in first-class fighting condition during an extended cruise at sea. The five large openings abreast of the smokestack are airports opening on to the hangar deck.

The battery of sixteen 6-inch guns is disposed as follows: Forward on each side of the hangar deck are two casemates carrying four guns on twin mounts, and aft on the deck below are mounted, four on each side, eight 6-inch guns, which are on twin mounts. On the deck below these are triple torpedo tubes of the standard type used on our destroyers. It should be noted that the flying-deck is cut in for two-thirds of its length to allow for the mounting of twelve anti-aircraft guns. In reducing the displacement of these ships to 35,000 tons heavy reductions had to be made both in the structure and motive power. A great part of this was achieved by removal of the heavy 16-inch gun battery and its turrets, and the heavy protective external and internal armor. Another great reduction was achieved in reducing the horsepower from 180,000 to 33,000, this being made possible both by the lighter displacement and by the reduction of the speed from 33¼ knots to 22 knots, which will be sufficient for the "Lexington" and the "Saratoga" to cruise with the fleet.

Inventor vs. Forger—I

Early Check Forging and the Transition from Plain Forgery to Raising

By Edward H. Smith

EVERY time eight thousand dollars are cleared through the banks of the United States one dollar is stolen by the forger and check raiser. The clearances in recent years have fluctuated in the vicinity of 400 billions annually. On the other hand, according to the estimates of various experts, including some officials of bankers' associations, the yearly amount stolen through misused checks is now about 50 millions. In 1880 the loss was probably not more than two millions a year and possibly as low as one million. In 1913 Mr. William J. Burns told the American Bankers' Association the stealage had been 23 millions. The writer estimated the 1918 loss as 30 millions, basing his calculations on reports which seem now to have been incomplete. It was more likely between 40 and 50 millions then, and the best informed specialists in bank protection believe that it has now passed the latter figure.

In addition to the pen-and-ink work necessary to raise the amount as it appears in words and figures on the body of the check, it was necessary also to alter the perforated figures at the upper left. The second installment of Mr. Smith's article will discuss this aspect of the check-raiser's work

The payee whose name appears bought this draft for $16; when he cashed it at the bank on which it was drawn it called for $1600, as shown

Check manipulation is, therefore, one of the commonest and costliest forms of property crime. Only swindling by means of corporate issues, which costs the American public several billions a year, and embezzlement or defalcation, which totals more than 100 millions, can be ranked above it. Bank burglary and robbery, types of crime which strike the average imagination as much more dangerous because they are committed in a more dramatic manner, probably yield the thieves about 2½ millions every twelve months, one-twentieth the check alteration loss.

Accordingly, there is and has been in progress a long-standing warfare between the banks and their supporting police organizations on one side and the check criminal on the other. Into this fight the inventor and technician has been drawn in more recent times and he has devoted untold energy and ingenuity to the tactical problem of flanking and routing the larcenous forces. To date he has achieved no victory. Indeed, the mounting figures of check losses would seem to indicate clearly that the tide of battle is swinging to the other side.

This struggle is another of those picturesque and romantic engagements like the contest between the maker of armor plate and the inventor of cannons, like the warfare between the safe builder and the burglar. Just as the inventor of guns has repeatedly brought forward weapons that made all existing armor worthless, only to have better armor negative his genius; and just as safe makers have repeatedly devised burglar-beating devices, only to have the robbers appear with effective counter weapons; so the inventors who have been fighting the marauding check men have developed one device after another, have apparently had the victory in their hands again and again, but have always, in the end, been circumvented. Here is a most moving and romantic conflict, which began centuries ago.

Criminal operations against checks must be divided roughly into two classes—forgery and alteration. Forgery is infinitely older. The patient orientalist, delving after the buried clay writing tablets in the ruined mounds that were the splendid cities of Sumer and Akkad, will tell you that evidences of precautions against signature forgeries are to be found among these antique cuneiform writings. And the Egyptian papyri bear similar testimony to the remoteness of the beginnings of written falsification. All intermediate civilizations must have had the forger to deal with.

The forging of bank checks is, to be sure, a fairly modern kind of crime for the good and ample reason that the check has not been in use for more than a couple of centuries. Whether there were check forgers in Europe before this crime was known in the United States is a point on which the writer has no information. They cannot, however, have been prominent. It is certain that check forgery is one of the forms of fraud at which American crooks excelled and it was in this country that the falsifying art was carried to its greatest perfection.

Two generations and more ago the American banks began to distribute their checks liberally among depositors to encourage the use of banks as mediums for transmitting money. It was necessary to educate the public to the convenience of the check system and this process is still going on. As soon as bank checks began to fly about in large numbers they attracted the attention of the criminal, and forgery began its great career. The method of criminal attack was quite simple. All the forger needed was a few blank checks, which were never difficult to get, and an authentic signature of some wealthy depositor. There was little trouble about procuring the latter, for a letter written to a business man was certain to bring a reply bearing his name in his own handwriting, plus whatever he might write in reply. There were no typewriters then and very few amanuenses. The forger then simply sat down, wrote himself a check for a large amount, forged the signature of the depositor and presented the check. He got the money, unless he bungled in some way, and the bank paid the loss.

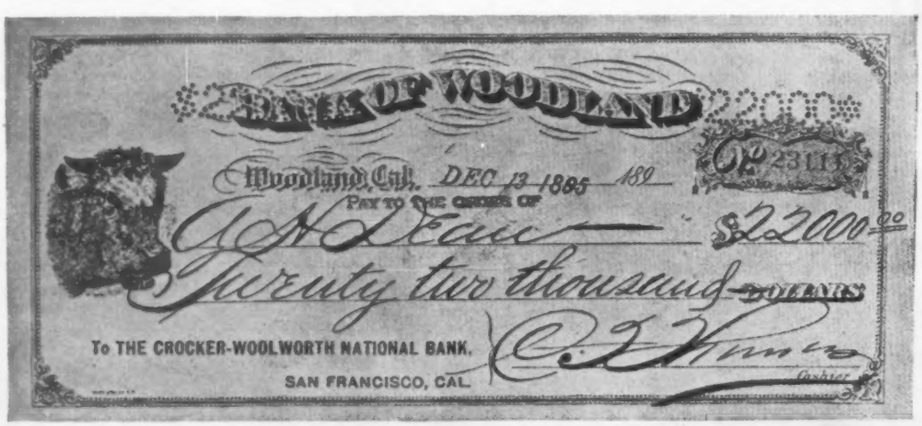
This crime was soon a fairly profitable kind of swindle, and its rewards brought about the development of a crew of expert penmen, such fellows as now do card writing and fancy pen prodigies at street fairs and carnivals. The name Jim the Penman came into popular speech through the machinations of these men.

Naturally, the banks, which had to stand the loss when they paid out money on a fraudulent signature, bestirred themselves mightily and cast about into every conceivable direction for means of combatting the penmen. Their measures were of two kinds. First they set out through the regular police and the private detective firms to catch and punish the professional forgers. To this end they kept a close watch upon checks that came in and began to study the work of many known "scratchers." Again, they pursued and prosecuted forgers with unrelenting severity. On the other hand, the banks began to appeal to technology and invention for relief.

The results of the first plan of action were interesting. Forgers began to organize themselves for protection against the banks and the law, with the result that there came into being a large number of the celebrated old forgery gangs which made criminal history on both sides of the Atlantic. Such gangs were made up of four divisions. At the top was the backer or chief conspirator, who usually financed the forging enterprise. Next to him came the expert penman or scratcher, who did the technical work. Below him ranked the agent or middleman and at the bottom were the putters or layers down, the fellows who presented and tried to cash the forged checks. These nether rascals worked under the direction of the middleman and never caught sight of the actual forger or the backer. If they were caught they might, if they chose, reveal the name of the middleman, but he was always a hardened and reliable underworldling, whose chief office was to protect the scratcher. Thus, for a long time a good many putters down and a few middlemen were caught and sent to prison, but only under the rarest circumstances did the law reach the real heads of the traffic.

These old-time forgers, who flourished between 1800 and the end of the last century, included in their ranks some of the best known criminal names in this country. There was Walter Sheridan, who forged hundreds of thousands of dollars in railroad bonds; Mack Shinburn, the forger who fled to Belgium to retire, got lured into fresh crimes and finally died in poverty, with a purchased Balkan title to his credit; the Bidwells, who committed the million-dollar Bank-of-England forgery; J. H. Livingston, who forged Cornelius Vanderbilt's name to a check for $75,000, made out to Henry Keep, the then president of the New York Central, reforged Keep's endorsement and got the cash out of a New York bank; Henry Wade Wilkes, head of the international forgery gang of American crooks that victimized bankers in every country in western and southern Europe; John Ross, who traded forged checks in Wall Street and got a million in gold for them; and Spence Pettis, of whom more presently.

First and last, the police and special detectives found these forgery gangs very difficult to deal with and for



Another famous altered draft—raised by Charles Becker from $12 to $22,000. Our photograph shows the draft after Becker was through with it

a generation the law made little progress against them. The banks therefore turned avidly to technical devices which promised to prevent forgery or render it more difficult. Two lines of experimentation were followed.

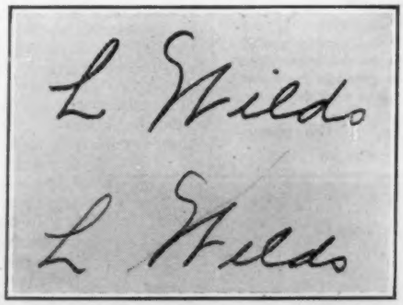
Bankers naturally turned to the obvious expedient of patent paper, for they had already had some experience with this material through the local issues of bank currency following the Civil War. They had also the example of the Federal Government paper currency before them. It was reasonable for them to suppose that a paper might be devised which could not be erased or manipulated without immediately revealing the forger's work. Accordingly, one type of so-called safety was tried and then another. All manner of ideas were applied to this substance and we see the fruit of their best in the bank check today. Soft fiber checks were tried, on the theory that if they were touched by any but the check writer who knew their secret, they would show the traces. But it happens that forgers know infinitely more about making out checks than business men, so the thing was a fiasco. Papers with a high gloss finish, others with hard surfaces, adapted only to special inks and some with special lines and designs were all tried and in brief time discarded. Then came the water-marked bank checks still in use today, those with intricate fine tracery and special designs worked into them, sometimes plus a delicate tinting.

The experiments with safety paper may be summarized in a word. The Federal Government uses for its currency the costliest and safest paper known, yet Federal notes are constantly being erased and altered by the crooks and the counterfeiting of these notes is too well established to need comment. Patent paper is, therefore, a failure, all the more so since banks cannot afford to use such costly materials for checks.

Patent inks occupied the talents of another class of inventors. The word indelible seems to have fascinated many of these well-meaning men, with the result that they spent a couple of generations seeking what is as mythical as the philosopher's stone. Under the bite of acids and alkaline solutions any ink ever devised breaks down. The older inks, which were indelible enough in water, were farcical failures as soon as any kind of bleaching chemical was applied. And modern chemical inks are not much better. They do, of course, exercise some restraint upon rank amateurs in the check falsifying business, but anyone who has any knowledge of inks and removers laughs at them.

One of the most logically conceived of the patent ink inventions revolved about the principle of chemical union between compounds in the ink and other affinities which occur in all modern paper. The men who worked on this idea reasoned that when the chemical ink met and combined with the other chemicals in the paper there would occur a chemical reaction that must defy the raiser and alterer. But, once more, this was only a theoretical idea and false at bottom, for it must be apparent to any student that whatever is built up by chemical action may be broken down by the reverse process. For every synthetic method there is an analytic counterpart, usually simpler and more certain. It might have occurred to those experimenters that a compound formed by the simple union of substances in the ink and paper could be broken down by a process similarly simple. This was the painful fact, as forgers and raisers soon demonstrated.

The outcome of all experiments with inks known to this writer may also be briefly stated: Good inks are worth using, for the reason that they cut down the likelihood of check manipulation by amateurs, but they are worthless against the expert. There is no solution of the problem in this direction.

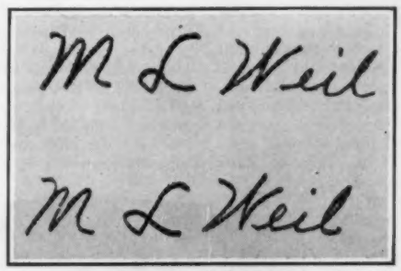


Genuine (below) and forgery. "Muscle-forging" of plain signatures like the ones shown is more difficult than of erratic or complicated ones. An illegible signature is the forger's particular delight

While the bankers and inventors had been working at these various counter measures against the old forgers and failing to perfect anything of decisive value, they had, nevertheless, thrown all sorts of difficulties in the forger's way, mainly by taking special precautions and employing police talent at all times. The forgers, though they could beat the inks and papers used against them, found themselves beset with other difficulties and in danger of being suppressed. For a little while the forces of the law saw victory crowding to their banners, and the forgery losses were greatly reduced; but——

The criminals did what they have done so often before and since. They changed the method and direction of their attack. Since check forgery had become difficult, why not stop it and turn the talents to alteration or raising? To do this, they had to get hold of genuine checks, with authentic signatures, but this feat was not so difficult as it may have seemed at a glance.

A book might be written around the romantic and ingenious methods used by check raisers to get hold of the paper they alter, but it will serve the purpose here to mention only a few of the more common. Perhaps the largest number of checks are got by rifling the mails, either in transit or at the collection boxes or at points of delivery, where there is any carelessness in handling. Almost of equal rank is the method of corrupting office employes and getting authentic small checks from them. It must be remembered that there are many amateur raisers who work in connection with professionals. Finally, there are the countless ways of getting good checks by tricks, such as buying a small check from a merchant; selling a storekeeper a bill of goods and asking him to pay by check; canvassing merchants with some small staple article, which every man buys, and then asking him not to pay till delivered, at which time he is asked to mail his check; getting delivery wagon drivers to ask for checks in payment and then buying these checks from the drivers for cash. The thing is endlessly various.



A genuine signature (below) and a forged copy (above). This is an example of "muscle-forging," i. e., direct copying by free-hand as opposed to tracing

An anecdote to make clear the transition of check crimes from forgery to raising. It deals, by the way, with the earliest big alteration case in this country.

In 1865 a well-known check man named W. G. Patterson perpetrated the notorious Pacific National Bank forgery in New York. He forged the name of a wealthy taxpayer to a large check made out to a high city official. Next he forged the endorsement of the official on the rear, presented the check at the bank with carefully prepared papers identifying himself under an assumed name. Before the teller, he then endorsed the check himself under this alias and got the money. For this job he was sent to Sing Sing, where he met Spence Pettis, already referred to. Pettis, one of the most resourceful crooks of the day, took Patterson under his wing and taught him the new art of raising while they were rusticating in prison.

At the expiration of his term Patterson made use of what Pettis had taught him. He opened an account with a Wall Street broker, did a little trading and then drew out a balance, receiving a certified check drawn on the Bank of Commerce and calling for $156. A few days later this check turned up at the Bank of Commerce most carefully altered and raised to the sum of $16,000. The bank passed it and paid Patterson the money in cash. Why not? The check bore the indubitably genuine signature of the maker and the bona fide stamp and initials of the bank's certifying clerk. To the teller's mind there could be nothing wrong with it, so the money went out.

At the end of the month the broker found that his balance was about $16,000 less than it ought to have been. He rushed to the bank and the raised check was soon produced. The broker sued the bank and a long and hard-fought legal engagement ensued, the first occasioned by check raising. In the end it was decided that the maker and not the bank was responsible for a raised check—and the broker lost.

Though business men did not realize it for a long time, this was a decision of the utmost importance to them and it marked the rise of a new era in check frauds. If raising was to come into currency the fight against check men would veer from the hands of the banks into those of the depositors, for the latter would be the losers. This precise thing happened. Forgery went more and more out of fashion and raising came to be almost the sole preoccupation of check manipulators. The banks breathed easier but their clients perspired and swore.

For the information of readers it may be said here that a generation and more of check litigation has, broadly speaking, upheld the decision of the courts made in the Bank of Commerce case, fifty odd years ago. The banks are responsible for false signatures, the depositors for altered checks. But this is stating the matter without proper precision. While such a general ruling underlies the law of the matter, the courts have lately refused to sustain this principle as a whole. The best legal attitude at present is that each case is a separate legal problem, to be decided according to the specific circumstances. At bottom every case depends on what is called detectability. If a check is so skilfully altered that the bank cannot reasonably have been expected to detect the fraud, then the depositor loses. If, on the other hand, the bank can be shown to have carelessly passed a crude piece of work, the shoe is on the other foot. But in common practice all this legal finessing means little. If your check is raised your bank will refuse to pay the loss and you may sue if you like; it will in the average case cost you more than to take your medicine with a smile.

When this truth dawned upon America's business men there was a fresh and frantic call for the services of the inventor, and he responded once more with various conceptions.

To understand the inventor's problem it is well to glance at the situation as regards checks, forgeries and alterations in the late 80's of the last century. Patent inks had failed completely, because, in spite of all claims and vaunts, they could be deleted. Patent papers presented little more difficulty to the expert, for he could bleach them, resurface, iron, retint, repair, rewater and restore them in every detail. Where they were covered with intricate designs, he made a tint block and a little later a photographic electroplate, by means of which he turned out an altered check that defied detection in the bank except when submitted to benzine baths and other bleaches. Banks make such experiments with checks after they have paid the money and been defrauded—not before.

Again, the check forgers had generally deserted their old technique for the new. Forgery was no longer a great problem. Raising was the evil of the day. It was this which had to be met.

As regards the criminal organizations, they were not only intact but they had learned to protect themselves better. The old gangs of backers, scratchers, middlemen and putters down continued active, but the scratcher now became a technician in check erasing, washing, repairing and general alteration. To aid them in getting genuine checks to alter, these gangs connected with bands of mail thieves and they began to look for office employees to corrupt. How was all this to be prevented? That will be the theme of the second part of this story.

THE crimes of violence in which the bank vault is the objective, and which Mr. Smith has so well discussed in our October and November issues, are by no means the only menace which our banks are called upon to meet. There was a time when the man who presented a check in payment of an account of any size rendered himself at once an object of suspicion. Thanks to the efforts of our banks to extend their business, this condition is reversed, and today it is the man who shuns checks and pays in cash who arouses our curiosity. The skillful crook has not been slow to take advantage of this state of affairs, and the result has been a campaign similar to the one already described by Mr. Smith. This time we have the banker and his depositors on the one side, the forger and check-raiser on the other—and, as before, invention working now with the one party and now with the other. Mr. Smith presents here the first chapter of this rather more refined conflict; he will conclude the tale in an early issue.—THE EDITOR.

Are You a Musician?

Professor Seashore's Specific Psychological Tests for Specific Musical Abilities

By Harold Cary

WHILE the sciences of physics and chemistry have become fine arts in which accurate measurements are not only possible but required, the attempts to measure the various capacities of the human mind have doddered along so far behind and remained so inaccurate that they have never been taken with too much seriousness. The best that psychological tests have been able to do in the past has been to show indications and determine rough averages. The famous army mental tests, which have been described in this magazine, were good, sound experiments which laid the groundwork for years of work by the mental experts, but even the most enthusiastic psychologists claimed no more for them than that they were rough indications.

Out of the jungle of ignorance of ways and means for precise determinations of mental abilities great things are to come in the next few years. How much we can expect is shown by the excellent work done by Professor Carl Emil Seashore. Most psychologists are agreed that he has done more and gone further to establish precisely certain particular abilities of the human mind than has any other student. His work in measuring musical talent is well-nigh flawless in so far as it goes—and he has gone much further than the layman can have dreamed possible as yet. He does not work with averages but with particular individuals. He is able to test any given subject and to say definitely how much musical talent that person has in relation to the average talent possessed by the group of persons already tested and numbering more than 5000. This is far different and far more important than determining the average talent of the 5000.

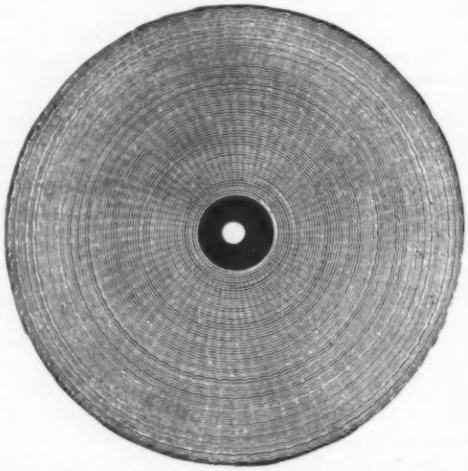
Musical performance of any kind has two sides: the mechanical one and the artistic or emotional side. To be an author or an executive you need in the way of tools only a place to work and pencil and paper. To be a musician you need physiological characteristics which cannot be purchased at the stationery store. Professor Seashore can tell you, with the aid of scientific instruments of excellent precision, whether or not you have the physiological tools which you need in order to be a musician. He has further tests for your ability to express yourself emotionally aside and apart from your tools, but these tests have the same inherent drawbacks that ordinary mental tests have. They are good, but they are not precise. Therefore it is the tests of the musician's tools that are of so great importance and it is because these tests are so well done that psychologists everywhere have hailed Seashore's work as something at last scientifically exact enough for them to stand upon as professionals.

It would be easy indeed to determine a person's inherent musical talent if music were entirely dependent upon some one physical characteristic such as the ear. There are those of us who can carry a tune or distinguish tunes and those of us who cannot. But so far we have not even stumbled over the threshold of investigation. One of the greatest of our classic composers was stone deaf! A man whose ear for pitch was relatively poor might play the piano beautifully. On the violin he would probably play sharp or flat continuously. He could not lead an orchestra.

Physiological musical talent is a hierarchy of talents impinging and overlapping upon each other. It has been Seashore's task to analyze and break down the sum total into its parts, examine these parts and put them together again intelligently. Incidentally it has been necessary to observe the effects of training upon these specific abilities and to determine whether or not a poor musical ear is improved by exercise. The answer is that the best training available does not change the results of the fundamental tests. A child of ten will make the same relative score ten years later after intensive musical training during the entire period.

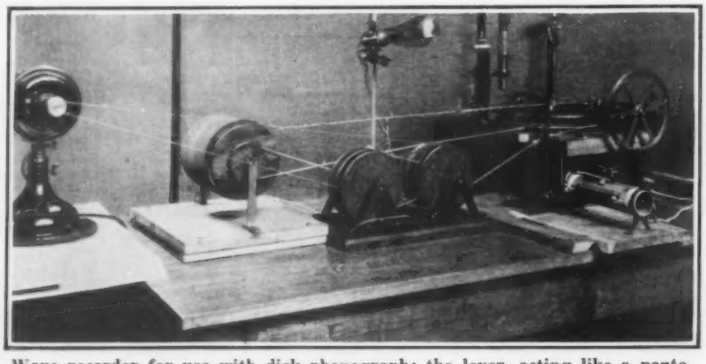
The simplest tests which Seashore has devised are now being used in hundreds of educational institutions to rate the capacities of children. For instance, in Des Moines, Iowa, five tests, which have been incorporated into a set of phonograph records, are given to all children in the public schools in the fifth and sixth grades. These five fundamental phonograph tests are for pitch, memory, rhythm, consonance and dissonance, and intensity.

The tonoscope for analyzing the pitch of the tones on a disk phonograph record



Each wave represents 1/100 second of the disk's motion. A discrepancy of as much as 1/10 wave in two successive circles would mean only an error of 1/1000 of a second in the motor's rotation; but there is scarcely a place where even so small an error as this appears

Illustrating the extreme accuracy of the phonograph motor



Wave recorder for use with disk phonograph; the lever, acting like a pantograph, traces the waves on a revolving smoked drum

The record for pitch is placed upon the phonograph and played through. The sounds are in pairs and the subject is to record on a ruled sheet whether the second sound is higher or lower than the first. The phonograph record is played through and the subjects make their notations. At first the differences between pairs is marked—almost a half tone. As the record goes on they become more and more difficult. The reverse side takes up the test at the point of least difference and becomes easier until it is finished. At the least difference Professor Seashore makes the two tones 1/108 of a tone apart.

The man or woman or child who can make a perfect score in this test has an abnormally fine sense of pitch, yet it does not mean that he has great capacities as a musician. It might mean merely that he would make an excellent piano tuner or adjuster of phonograph motors. The person who makes an exceedingly bad test is not out of it yet either. He probably could never be a composer; but he might be a pianist, for the notes of the piano are fixed.

The test of time is similar to the test for pitch in method. Three clicks made with cocoanuts are recorded, to make each individual test. The subject is to state or write down whether the interval between the second two clicks is shorter or longer than the interval between the first two. This is not a complete test of the sense of rhythm in that you might have a perfect score on this record and still not possess other qualifications necessary to rhythmic action, but if your percentage was bad you could be very suspicious of your ensemble of musical talent. Incidentally it might teach you the fundamental reason why it was difficult for you to learn to dance.

The volume test is to tell whether the second of a pair of sounds is louder or softer than the first. The value of this ability is obvious. All the finer shades of musical expression are dependent upon the musician's ability to distinguish and then produce fine shades of difference in intensity, not only of whole passages but of particular notes.

Consonance is tested by playing pairs of chords, with answers as to whether or not the second of the pair is better or worse than the first. This is a test, not of your taste, but of your ear. Dissonance may be pleasant to your ear—it is often used in classic musical compositions; but you should nevertheless be able to tell the difference between chords which clash and those which are smooth.

To test memory, the record sounds a series of from two to six notes and then repeats the series with but one change. As the series is being played the subject counts: one, two, three, four, five, six. This is to place by association each note played, for the second time through the little series one of them is to be changed and the answer is to be: "Number four," or whatever note you think has been changed. Musical memory is obviously of great importance. It does not necessarily accompany musical intelligence, but to a great degree the accomplished musician must have a well-developed memory of this character. This is "absolute memory." It cannot be developed to any great degree, although useful memory is a faculty that can be improved to some extent according to many scientists.

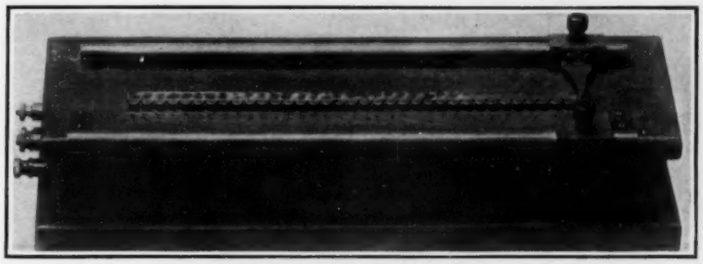
The enormous economic importance of such tests as these lies in the amount of money which is wasted upon children in the United States who can never become musicians. It has been estimated that the people of the United States spend more than $40,000,000 a year *more* for musical training than for all high school, normal, professional and college teaching. The thousands of tests which have been made show that the good and bad receive training indiscriminately. Moreover, the difference between the good and bad is enormous. Quantitatively the good pupils have ten-fold, fifty-fold, even a hundred-fold better tools.

These dragnet tests for use on any and everyone are but a beginning. To go more deeply into the capacities many more abilities must be investigated. For these tests many special instruments have been devised or adapted for special use by Professor Seashore.

For performance upon any musical instrument (and in this category the use of the voice in singing may be regarded as a performance upon a musical instrument) one of the chief requirements must of necessity be adequate motility. This might be called the ability of the muscles to do quickly and accurately what the brain tells them to do. A tennis player needs good motility; so does an expert typist. A simple way to test your own motility roughly is to try to see how many dots you can make on a piece of paper with a pencil in five seconds. Try it as many times as you wish for practice and then make your test. You will make somewhere between twenty and sixty. After months of practice you might improve your record, but some other test would put you in the same class that this test puts you in before you practiced on it. More accurate results may be attained by use of a recording chronoscope made in any of a number of forms. The graphic record here shows the regularity of the action in addition to the number of movements performed.

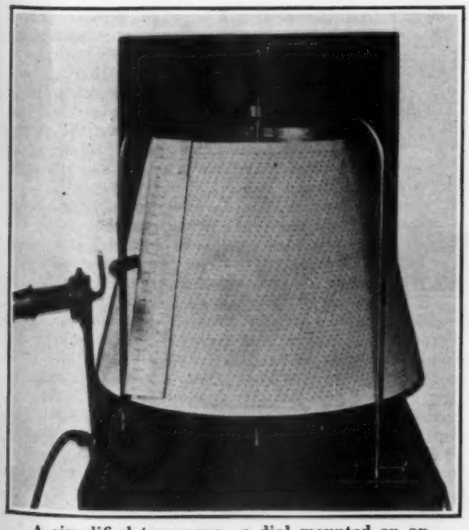
Physicists who are students of sound have pretty well proved that timbre is due to overtones. It is these which make the difference in the character of sounds produced by the saxophone and the flute, or any other instruments, including the voice. The person who is to be a real musician must have an inherent sense of timbre. For testing this greatly varying talent a set of tuning forks in harmonic series is used in conjunction with resonators. The overtones of these forks can easily be emphasized or subdued; and comparative, quantitative tests shows the value of the particular ear in its ability to distinguish these mutations.

One of the most interesting instruments which Seashore has devised is the musical-touch audiometer. We speak of one pianist as having a better touch than another. We know that the touch of Hofmann is very different from the touch of Paderewski and yet at the same time a little reflection will quickly determine that this characteristic is a most difficult one to define. The audiometer, however, does a beautiful job of testing because it determines how closely an individual is able to approximate an effect which he wants to produce; yet at the same time, no matter how skilled a musician he may be, he has never before attempted to play such an instrument as this one.



The musical-touch audiometer

An electrical tuning fork is placed in a circuit with thirty-five different steps of resistance to produce a note ranging from inaudibility to a sound which is disagreeably loud as heard in a telephone receiver. A contact rider is placed in the hand of the subject and the tester. The subject is blindfolded. The tester slides his contact along the posts with a sweep of the hand which takes about one second, ending on a certain note which he has determined to use. This he sounds for a full second, and again and then again to enable the subject to fix it in his mind. By ear alone the subject tries his hand at it. After he has had fifteen practice trials to get the hang of the test he is given fifty tests, ten different intensities being used to vary it.



A simplified tonoscope—a dial mounted on an ordinary phonograph

Research on this test, showing its value in establishing the quality of touch, was made among a large number of music-school students of the piano. The teachers were asked to make independent ratings of all the subjects and these ratings were compared with the scores made upon the audiometer. The two ratings were so similar as to prove beyond doubt great reliability of the mechanical test.

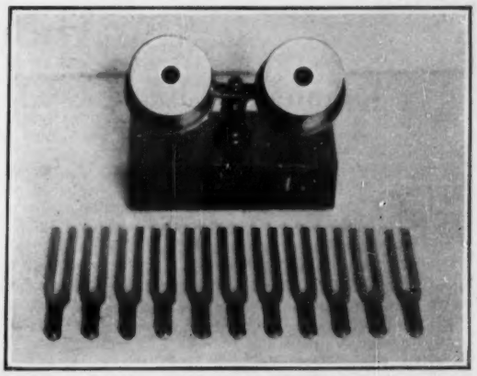
One of the most valuable instruments for use in analyzing musical ability is the tonoscope which has been described in a previous issue of the SCIENTIFIC AMERICAN. By means of this instrument a motion picture of the tones being played or sung, in relation to their pitch, is shown before the eyes of the performer. A person playing the violin may see exactly how many vibrations per second he is out of tune. A singer may see his whole method of tone production.

Professor Seashore, to establish the methods of the best singers, arranged the tonoscope to record the sounds made by a phonograph record in graphic form. The pitch factor in artistic singing was thus laid out upon graph paper so that the differences could be studied. No matter who sings the note it seems always divided into three parts: the attack, the sustained tone and the release. Analyses of notes sung for the phonograph by Melba, Gluck, Destinn, Alda and Eames shows definitely the characteristics of these singers. One of them, for instance, attacks one-tenth of a tone low, rises above the true tone and falls again, having gone through a variation of a full quarter of a tone. All of them show similar variations. Several notes, *g*'s, for each singer showed that this note for Destinn and Eames was 390 dv. (vibrations); for Alda, 394 dv.; for Melba, 393 dv.; for Gluck, 398 dv. The tests of these voices showed that Melba and Gluck have the steadiest voices with the fewest and smallest fluctuations. Eames has a steady voice with a few fluctuations, but very marked ones when they occur: Alda and Destinn manifest unsteady tones with fluctuations large in number and extent.

The accuracy of such observations of tones produced on the phonograph would be questioned if the phonograph motor were inaccurate. Professor Seashore has shown that it is so accurate that the error is negligible. Making a record of a tuning fork's vibrations he showed that in no place was there a variation so great as one-thousandth of a second. The waves made a remarkable geometric pattern. For this reason he has been able to utilize the phonograph as the basis for many of his tests and he has gone so far even as to construct a small tonoscope with a piece of cardboard shaped like a cone which rides on the turntable and gives accurate readings of pitch variations.

The components of the musical mind, as worked out by Seashore, are divided into five sections, with many subdivisions, each of which must be studied in order to make intelligent tests of musical talent. Musical sensitivity includes the senses of time, pitch, extensity and intensity, as well as the complex senses of rhythm, consonance, timbre and volume. Musical action requires the ability to control pitch, intensity, time, rhythm, timbre and volume. Musical memory and imagination requires auditory imagery, motor imagery, creative imagination, memory span and learning power. Musical intellect requires intelligence, free association and the power of reflection. Musical feeling requires good taste, emotional reaction to music and emotional self-expression in music.

We have attempted to describe here only those tests which are fundamentally physiological. They form a sound basis for judging inherent talent. The remaining tests are somewhat similar to Binet tests or their successors in mental examinations. As pointed out at the very beginning of this article the greater importance of Seashore's work is due to the fact that he has devised means for testing talents which are dependent upon inherent qualifications of the subject and for this reason can be far more accurate in his judgments than can the man who examines more vague attributes of the human mind.



Set of pitch-discrimination tuning-forks with resonators, used for testing the sense of timbre

As Professor Seashore says: "The gift of music is inborn, and inborn in specific types which can be detected early in life, before time for beginning serious musical education."

Specific proof is presented of these facts. Some of Professor Seashore's "discoveries" have been endowed by wealthy persons. They already give promise of becoming brilliant, nationally-known musicians. One boy, whose father wished him to be trained in business in a small Iowa town, was obsessed with the desire to become a violinist. His father agreed to let the decision rest with Seashore as to which course was to be followed. The boy, now twenty years old, is giving a series of violin recitals throughout the country and is being sent next year to Europe for further training. He has been hailed by critics as the "Iowa Kreisler." He came within an inch of being just another Iowa hardware merchant.

The Value of Psychological Tests

IN *School and Society* for July 29, 1922, Professors S. S. Colvin and A. H. MacPhail present an excellent and important article in which there is discussed the value of Psychological tests, as shown by four years' use at Brown University.

The attempt to measure innate intelligence through the use of intelligence tests has in the last few years assumed a position of predominating importance. The movement is roughly 17 years old. Its earlier developments were relatively slow and its practical significance limited. Not until 1918, with the beginning of the use of group intelligence tests, did the great possibilities of employing mental tests in school administration and educational guidance become clearly understood. Recently the compilation and use of mental tests have grown with astonishing rapidity until today the subject of "mental testing" is discussed more extensively and frequently than any other topic in the realm of education or of scientific psychology.

The authors review recent criticism, both favorable and unfavorable, describe their own work, present several tables, and conclude:

"High" men (i .e., "high" by the tests) have a good chance of graduating, "low" men much smaller chance.

Roughly speaking, three-fourths of the "high" men do satisfactory scholastic work. Only one-third of the "low" men do so.

Among the men who receive "warnings" at mid-term the "low" men outnumber the "high" seven to one.

"Low" men are from five to seven times more likely to have poor academic records at the end of the first semester than are the "high" men.

As a group, the academic work of the "high" men is far ahead of the class achievement as a whole and the work of the "low" men is of a distinctly inferior quality.

Coupled with poor academic work at the end of the first semester a low psychological score is a reasonably just criterion for dismissing men from college at that time.

Four times out of five the scholasic honors awarded in college go to "high" men. The rest of the chances belong to the "medium" men, since the "low" man is practically out of the running. He may have about one chance out of a hundred of getting one honor, but almost without exception those who get more than one honor are "high" men.

About the Radio Round-Table

Opinions of Radio Leaders Regarding the Past, Present and Future of Broadcasting

RADIO BROADCASTING in its present form was built up overnight. Due to its complex nature, the lack of precedent or parallel to go by, its lure for opportunists who have done the young art untold harm, and other deterrent factors, it was to be expected that this hastily and poorly erected institution should be inherently weak and unsatisfactory to the radio industry and the public alike. That is precisely the present state of radio broadcasting. It is poorly organized, lacks direction, is insecurely financed, is suffering from an over-production brought about by the efforts of firms and individuals who should be engaged in other occupations with which they are more familiar, and, in a word, should be taken down to its very foundations and reconstructed along safe and sane lines.

So far as the general public is concerned, radio broadcasting is looked upon with three different frames of mind, depending on the experience of the individual. First, there is the individual who knows nothing about radio, and he is very rare indeed. That individual, of course, is ready to be introduced to radio and, if the work is properly carried out, he may become a radio novice in short order. Secondly, there is the individual who has heard a loud-speaker in front of a hardware store or poorly managed radio shop, and has experienced the shrieks and groans and hisses and whistles which were said to be radio. That individual is through with radio. His mind is made up, and it will require a skillful and persistent campaign through advertising and salesmanship to disillusion him. The loud-speakers, by the way, in the hands of inexperienced persons have done more harm to radio than almost any other factor. Thirdly, there is the radio novice who is reasonably satisfied with the present broadcasting situation, although he admits it could be greatly improved and expects it to be improved in the future. Meanwhile, this individual, whom we will call the novice, is making the most of an unsettled situation.

Now these facts and many others are known to radio men. The opportunists may be disregarded from our present consideration, for they have little interest in the art except as a means of immediate financial gain. For the most part they have already left the radio field *en masse*, and have moved on to some more alluring field of activity. Meanwhile the serious radio men who are in the broadcasting art to stay, must clear away the wreckage of a wild boom followed by an aftermath which had much the appearance of a collapse, and prepare for the substantial and steady development that is to follow.

It has often been held by the laity that radio broadcasting began too soon. It should have been incubated in the laboratory and reared to the adult stage before its debut before the public. Yet, strange to say, the radio men whose joint opinions are incorporated in this article are unanimous in their belief that radio broadcasting did not start too soon. It is their combined opinions that if broadcasting had not started when it did, we would not have gone as far as we have. Indeed, it is immaterial when broadcasting started; the same result would have obtained as far as the creation of a demand for receiving equipment is concerned. Regardless of what manufacturers or distributors may now say, it is very doubtful that anyone in the radio business could foresee the tremendous radio market created by the broadcasting activities. Many thought it would create a market, but they were not sufficiently sure to go ahead with heavy investments in receiving sets and parts in order to be ready for the radio boom.

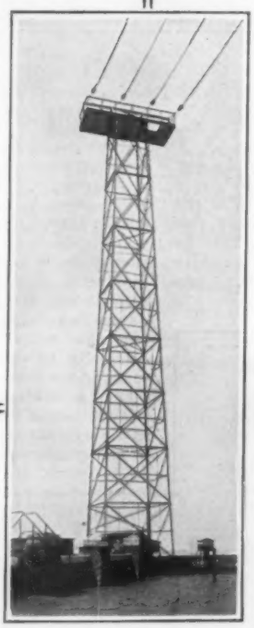
The trouble was not that the radio manufacturers of the country did not know how to build receivers or transmitters. It was simply that they were not equipped to make good receivers in quantities sufficient to meet the sudden public demand; and, inasmuch as the public demand was an absolutely unknown quantity, it was impossible to expect manufacturers to be prepared. The natural consequence was that numerous manufacturers and dealers in every other line but radio, experiencing a slump in their own line, turned to radio and flooded the market with inferior apparatus.

Technically speaking, the radio telephone was ready for broadcasting. During the war this method of communication was rapidly developed, and the modulating system of R. A. Heising of the Western Electric Company, introduced during that period, was the essential link between the radio telephone and the broadcasting of good music. The public was well satisfied with what they heard during the first few months, even if the programs consisted almost entirely of phonograph and automatic piano selections; and as their demands for better quality increased, the technique of the art developed in step with the requirements.

All in all, there is little fault to find with the development of radio broadcasting. It had to be put to the acid test of everyday use in order to bring out its crudities and correct them, one by one. Perhaps, as one of our informants, we might wish that the growth of popular radio could have been a little slower, because it would have made for a healthier condition. Still, it is probably true that most all developments are launched before they reach perfection, and radio is no exception.

THERE never was anything like the radio broadcasting boom. It came overnight, the public immediately took to it, a demand of overwhelming proportions was created for radio equipment, thousands of inexperienced firms and persons got into the radio business, millions upon millions of dollars' worth of apparatus was dumped on the market, the bottom fell out with the first signs of "static" at the approach of last summer's warm days, at a time when production was reaching the peak, and a serious slump followed.

What is the trouble? How can it be rectified? What shall we do about it? These questions have been put to many radio men. Among those who have given us answers which are incorporated in whole or in part in the accompanying article are: Mr. R. W. King, American Telephone & Telegraph Company; Mr. C. B. Cooper, Ship Owners' Radio Service; Mr. L. G. Pacent, Pacent Electric Company; Mr. Herbert H. Frost; Mr. C. D. Tuska, The C. D. Tuska Company; Mr. R. M. Keator, DeForest Radio Telephone & Telegraph Company; Mr. H. P. Davis, Westinghouse Electric & Manufacturing Company, and the originator of modern broadcasting service; and Mr. Paul B. Findley, a close student of the broadcasting situation who speaks for himself and not for a leading electric company with which he is connected. —THE EDITOR.



Further unanimity of radio opinions is to be found in the all-important matter of radio laws. All are agreed that the existing laws and their administration are wrong in several particulars, and that the present "mess" in which radio broadcasting finds itself is primarily due to the shortsightedness and procrastination of the Government.

Let us be frank about our present ills. There are too many poor broadcasting stations and not enough good stations. The latest available figures indicate that on October 5 there were 546 broadcasting stations in the United States, very spottily distributed throughout the country so that some sections were highly dotted while others were relatively bare. Up till quite recently all these stations have been operating on one and the same wave length, 360 meters, giving rise to endless confusion and, in congested radio districts, spoiling broadcasting completely. Of late, however, the authorities have established what is known as the Class B broadcasting license, which entitles the holder to broadcast on 400 meters. Stations receiving such a license must be of the highest possible type, both with regard to equipment and programs. Out of the 546 stations above mentioned, only 11 have been given Class B licenses. Hence this move, while it is in the right direction, is but a feeble contribution while the present pandemonium goes on in full swing.

The plain truth is that broadcasting caught our legislators unprepared. As one informant tersely puts it, there were no radio telephone laws! The present radio law was designed before radio telephony existed in everyday form. There is a bill in the House and Senate at the present time which, if passed, will give to the Secretary of Commerce regulatory powers, and this bill should be brought up for public hearing and passed without delay. A discussion of the merits of the bill at this point would be too long; furthermore, the preliminaries in the drafting of the bill and its final scope were covered some time ago in these columns. However, the main thing that any radio law should accomplish at the present time is to create a place in the law for radio telephony and give to the Secretary of Commerce the power to regulate the art, so that he can make regulations that may be changed or revised as the art of broadcasting progresses.

Are there too many broadcasting stations? Some say yes, especially with regard to the poorer kind of stations, while others say no. The proper radio laws, giving several bands of wave lengths for different classes of stations, might do much to increase the possible number of broadcasting transmitters with a minimum of interference.

The existing radio laws and their administration are wrong in several particulars. These will have to be corrected as soon as possible along the following lines:

(a) Broadcasting licenses to be issued only to organizations and institutions which are strong enough financially to put out really worth-while programs. (b) No experimental licenses to be issued to individuals unless they have sufficient funds and are otherwise evidently in a position to make some real contributions to the art. (c) No amateur licenses to be given to spark transmitting sets; only continuous wave transmitters to be allowed to operate. Much of the present dot-dash interference is due to spark sets which do not send out sharp waves and therefore cause interference over a wide range of wave lengths. (d) Wave bands to be allocated to certain types of programs, such as, jazz, classical music, vaudeville, educational lectures, news, etc., and any station to be allowed to transmit on the appropriate wave length for the material that it is going to put out. If the above changes are made, according to a close student of radio broadcasting who has formulated the foregoing suggestions, there will not be too many broadcasting stations, since they can arrange among themselves to send out different kinds of material at the same time and thus use several wave lengths.

So much for the radio laws. But who is to do the broadcasting and who is to pay for the cost? As is well known, the broadcasting stations today are for the most part operated by manufacturers of radio apparatus, who charge up the expenses of broadcasting to the sale of radio apparatus. Then there are progressive newspapers, who carry on broadcasting activities as part of their service to the public and for publicity purposes. There are schools, universities, institutions and other organizations carrying on broadcasting as part of their experimental work and for the benefit of the public. Finally, there is the telephone organization which is conducting the highest grade broadcasting at present, by way of preparation for future activities.

Still, the broadcasting end of the radio art is unsettled. The evil hour is fast approaching when the persons who play and sing for us and tell us so many

interesting things via radio broadcasting are going to exact payment for their services. The broadcasting stations, in turn, will have to collect revenue from the "listeners-in," either directly or indirectly. The present situation is too good to last, we may be sure of that.

Radio men have two ideas in mind as regards future broadcasting activities. One is to form an association of manufacturers, jobbers, dealers and others interested in radio, for the purpose of maintaining either a local station or a nation-wide chain of broadcasting stations. Each member of such an association would contribute his pro rata share towards the support of the broadcasting activities, based on his business or some other equitable arrangement. Thus the available funds would be sufficient to maintain high-grade broadcasting stations, and to pay for such talent as would demand payment. The second idea, which also finds wide approval among the radio fraternity, is for the Government to take a definite rôle in broadcasting. Many feel it is the Government's duty to maintain several broadcasting stations scattered throughout the country and serving not only for the dissemination of news, Government reports, weather forecasts, agricultural prices and advice, and imported announcements and messages by the nation's leaders, but also music, educational talks and so on. Thus the Government would bring about the monopolistic control of broadcasting. Both plans are good; it seems probable that one or both will find expression in the no distant future. In either event, it must come about that somehow the public will pay for broadcasting, either through the purchase of radio apparatus or through a tax.

While most radio men feel that broadcasting can only reach its ultimate goal through centralization of efforts, a persistent minority resent such a monopoly and prefer the present free-for-all broadcasting activities. Perhaps this feeling, in large measure, is due to the fear that a single commercial organization might obtain absolute control of broadcasting and then do much as it wished to its own selfish gain and to the possible detriment of the art. Such a fear, however, is no doubt without foundation in fact.

The present broadcasting situation is little short of ludicrous. In some sections there are so many broadcasting stations that in order to reduce interference each station is allotted certain periods for transmitting its programs. Thus many of the stations are idle for a good part of the time, and heavy investments are represented in transmitters and studios which can operate but a very small part of each week. Why not concentrate all those investments, equipments, talents, technical skill and so on into a smaller number of well distributed stations? Since there is no money in broadcasting, why not reduce the overhead and concentrate the efforts to the end of getting better results for the good of all?

It might be said in refutation of that plan that the present scheme of broadcasting gives plenty of variety. One can tune in jazz, classical music, a political speech, crop reports and whatnot by selecting any desired station within range, if one is favorably located and has a high-grade receiving set. But it is also true that a radio novice, located in a congested section, cannot tune for any desired station. The nearby station must be listened to, for it drowns out everything else. Thus there is, after all, little selection except for the chosen few located at some distance from stations. But if broadcasting were to be centralized in a group of well distributed stations, it would be possible for each station to include several transmitters each tuned to a different wave length, and each wave length, in turn, devoted to some special form of program. Thus jazz would be 360 meters; educational lectures, 380; classical music, 400 meters; Governmental bulletins, 425 meters, and so on, with the wave lengths perhaps farther apart than here indicated so as to facilitate definite tuning. Since each station would broadcast the various wave lengths simultaneously, and since the waves would be of equal strength at any receiving station, tuning would be facilitated.

Our next phase of radio is the industrial side. Here again we find a state of chaos. There are too many engaged in radio manufacturing, especially small manufacturers, and too many side-line dealers. The production of low-grade apparatus is so simple that it attracts a lot of men with some electrical knowledge and a little capital. Yet there is a long jump between this sort of thing and high-grade equipment that will give an undistorted rendering of the material put into the transmitter. This requires careful attention to the most minute details, and it would appear that only a very few manufacturers have any appreciation of this fact. Only those manufacturers who realize this fact and who have long been in the radio business are qualified to stay in it. Thoroughly equipped laboratories and competent engineering staffs are fundamental essentials with those manufacturers who are permanently identified with radio.

In this connection it is interesting to hear from Mr. Louis G. Pacent, Director of the Radio News Laboratories, which were organized for the purpose of testing equipment and aiding manufacturers along proper technical lines. "It is sadly true that 80 per cent of the equipment submitted to us is rejected, and that most of the rejected material is manufactured by new manufacturers who do not know anything about the principles of radio engineering," states this informant. "It is surprising to note that a number of these concerns are old-established electrical or mechanical companies who are experts in their own lines, but fail in radio because they do not know its principles. Some of their equipment looks wonderful from a selling standpoint, but it is hopeless in radio. In my estimation, the companies that are qualified to stay in the field are the companies who have been connected with radio for many years, and who know radio from an engineering standpoint. After all, radio can well be compared with the automobile industry. Today, which are the outstanding automobile companies? Those companies which started with the automobile industry and are headed by automotive pioneers. The same must be true in radio."

As for present and future uses of radio, most radio men agree that the public wish music more than educational lectures. By music is meant either classical or jazz numbers, and it is safe to assume that the great majority prefer the latter. Indeed, there has been too much classical music wasted on the radio audience as it is, and entirely too much duplication of operatic selections and songs. When dealing with such a large audience as that of the broadcasting station, it must be borne in mind that popular music is certain to please the majority, and, after all, it is the majority that rules. Broadcasting programs should use the vaudeville stage for their pattern.

Many of the lectures or talks delivered by radio are uninteresting. The average radio listener, sitting at home after a hard day's work, does not care to listen to some such subject as the preparation of oils for lubricating purposes or the selection of glass for the manufacture of spectacles. There have been too many uninteresting subjects of that kind wished on the radio audience, although it is well to understand that until such time as the broadcasters have money with which to pay for radio talent, they must and will continue to fill in with such talks. We must not be too hard on the broadcasters. Remember, they depend on gratuitous services. They cannot buy nor command talent. That is why their programs, at times, are disappointing and quite flat. That is why, too, they must resort to the phonograph or automatic piano, when the promised singer or musician fails to turn up. When once broadcasting is put on a paying basis, there will be better programs and certainty of performance. Meanwhile, let us add that the broadcasters are doing remarkably well in what must be considered a very young art.

The biggest development in the future of broadcasting is along educational lines, where a speaker before one audience can send his message to any number of audiences located at widely distant points. Broadcasting has now reached such a point of reliability that there need be no hesitation about scheduling lectures to be given by radio. It is expected that within a short while universities and colleges will find it their duty to broadcast extension courses which will encourage home study.

The reporting of sporting events is an important branch of radio broadcasting. Every time a sporting event has been broadcasted, the local radio market has reacted most favorably, indicating the popularity of this use of radio. It would be well for broadcasters to consider the broadcasting of Government activities to a greater extent, such as the broadcasting of Congressional activities so that everyone with a radio receiving set could listen to the speeches of various men in Congressional session.

Modulation, which means the impressing of sounds on the radio waves, can be improved, but our principal need is a recognition that the transmitter which picks up the various sounds has a much shorter range of intensities than the human ear. More care can be given by the studio managers to see that the transmitter gets enough sound and yet not too much. Studio managers are learning day by day about acoustical effects and their studios and transmission are getting better and better.

Meanwhile the radio industry must solve its more pressing problem. And the best way to proceed, according to our informants who are also agreed on this question, is to form a national organization composed of manufacturers, dealers, broadcasters and the public, for the purpose of moulding this wonderful thing into a definite industry on the one hand, and to eliminate the undesirable element which has done so much injury to the art. This same organization must pool the various broadcasting activities to the end of giving better service to the public. If these things are done, the present over-production of radio junk and the overstocked condition of the retailers will ultimately take care of themselves. As it is, the 1923 business will no doubt be as great as that during the 1922 boom, for the reason that much of the boom was fictitious and never materialized except on paper. Some prices for sets are much too high and the public will not buy, because the public considers radio in the same class as the phonograph. Meanwhile we start the next year's business with much wisdom, better equipment, better companions, and with a public that knows what to expect of radio.

Typical radio telephone broadcasting station of today. The radio transmitter is located behind the velvet-draped railing at the right, while the microphone, covered over, is in the center

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Our Offer to the Psychics

THREE thousand years ago the Delphic oracle was in full swing. The priestess sat over a crack in the rock, inhaling the soporific and ecstatic vapors — vapors of which her contemporaries made much hocus pocus, but which lose their mystery in the hands of modern science. In the exalted state to which she presently attained, she gave utterance to prophecies which all Greece and much of the external world received with the greatest attention.

Modern critics point to the double-faced character of these pronouncements—as when Croesus was assured that by going to war with Cyrus he would destroy a great empire, which turned out to be his own. Other cynics suggest that the priests maintained an information service in foreign countries, which made it possible to give sound advice from sound premises. We have no doubt that among its contemporaries there were persons hard-headed enough to point out both these alternatives; and that when these scoffers were bold enough to air their views, bitter controversy would ensue as to whether the priestess was inspired or drunk or merely very canny.

Human nature is essentially a constant; and in no manner can this be made more apparent than by setting the Delphic priestess before the medium of today. Throughout the 30 centuries that have elapsed, the human race has at all times and in all places manifested a willingness to accept anything which purported to put it in touch with the unseen forces. Always we have had soothsayers and haruspices, oracles and fortune tellers, witches and prophets; the medium of the latest 1923 model is but the same old thing, brought up to date. And always we have had a very respectable portion of the community eager to accept the claims of supernatural powers, always a residium of scoffers unwilling to accept. The thing seeks a scientific basis today simply because the twentieth century medium is living in the twentieth century; approximation to twentieth century methods is as necessary in her case as it would have been out of place in Delphi.

The outstanding feature of all this is that we have never been able to settle the thing for good or for bad. The controversy of today is essentially the controversy of 1000 B. C., translated into modern terms and given a modern setting. It is perhaps too ambitious to hope that one may ever settle it permanently, so that it will stay forever settled. But it is not too much to hope that one may be instrumental in imposing a conclusion upon one's own generation—a conclusion that will at least stay put while that generation grows old and dies off in favor of another, with a shorter memory.

The manifestations claimed by the mediums of today: Do they occur as objective phenomena, and if so, how? Lots of people have settled one or both questions to their own complete satisfaction. But when we let them argue the matter for the benefit of the rest of us, we find that either, like McKenzie, they have done the settling so poorly, or like Black have presented their case so unfairly, that one is unable to decide the merits of the issue.

Is the SCIENTIFIC AMERICAN too ambitious in imagining that seances carried out under the immediate supervision of its editors, observed by them, reported by them at first hand in its columns, will be any more determinative than the procedure which has heretofore ruled? We believe that perhaps we are not; that we stand so conspicuously as a disinterested party seeking only the truth and willing to give both sides a square deal, that our negative findings would get attention from those eager to believe and our affirmative ones from those inclined to scoff. Surely we do not exaggerate when we claim a greater audience than any other agency of repute which has previously attempted direct investigation of the psychic problem; with corresponding ground for greater hope that our findings, whatever they be, will enjoy a wider circulation and a wider acceptance. It is with some such thoughts as these that we make the offer announced on page 389.

Forest Preservation a National Duty

THE MOST cursory reader of dispatches from Europe during the past few months must have noticed how largely the German forests have figured in the discussion of ways and means for reparation. Unable to cover the total indebtedness in cash, the German government has suggested that a large portion of it might be paid in lumber and various forest products. At the same time France points to the great denudation of her forests, both by the Germans in overrun French territory, and by the French themselves in meeting the large demands for timber for their own military purposes. The British also made deep inroads on their own forests. Both they and the French are systematically planting the cut-over areas with a view to restoring their justly famous forest lands for future generations.

Fortunately for the three countries named, the art of forestation was long ago brought up to a high pitch of efficiency. Had not replanting been carried on side by side with cutting, the valuable and extensive timber lands in these countries would today be as completely swept bare as were those of the more ancient countries, in which scientific forestation was unknown and where evidently no thought whatsoever was given to the needs of the future.

Now the fact that Germany, heavily populated as it is, and has been for many a decade, should be in a position to offer the products of her forests as one of the most important sources of reparation payment, is full of national significance for the people of the United States, where for centuries we have been cutting down the magnificent virgin forests of the country, without taking measures to replant the vast areas from which the timber was being swept away.

According to the president of the American Forestry Association, Charles L. Pack, statistics show that there is 11 per cent more timber in the Black Forests of Germany today than in 1914, when the war started. He informs us that he has sent millions of tree seeds to Europe to help to reforest the areas ruined by the war. "I have done this," he says, "in the hope that the people of this country would see the great value of maintaining that backbone of all industry, forest products." In emphasizing the fact that the forest areas should be well distributed, he quotes the payment in the state of New Jersey of $5,000,000 a year in freight rates on imported lumber. The states bordering on the Great Lakes, once the greatest producers of lumber, are now importing it to keep their factories busy. The same anomaly is to be found in New England. Chiefly in the East and Middle West, we are told, there are 81,000,000 acres of idle land, good for nothing but growing trees.

Of late years it is true that, thanks to the American Forestry Association and to the efforts of such tree lovers as Gifford Pinchot, a beginning has been made in forest conservation, and both to individual efforts and the work of the Association every credit is due. On the other hand, the commercial exploitation of our forests has been and still is at such a pace that the standing timber throughout the country represents today but a fraction of the glorious forests which were found by the early settlers of America. So far as the power of the government may be legitimately employed to stay the hand of the spoiler and demand that where he cuts down the old timber he shall plant the beginnings of the new—so far as this may be done, every effort should be made by the country to bring about its early accomplishment.

The Fundamentals of Work and Power

THE LAYMAN always, and the technician frequently, suffers from confusion between the terms momentum, force, work and power, and the ideas inherent in them. It will be worth while to examine these ideas briefly.

We all know what velocity means, and are subject to no confusion in thinking of it. The first step in building up more complex notions comes when we agree with Newton that of two bodies at equal velocities, that one displays the greater "quantity of motion" which possesses the greater "quantity of matter" or mass. The more matter in motion, the more motion. So we give a name to the product of mass and velocity; we call it *momentum*, and we understand it to mean quantity of motion.

Newton next noted that a body once in motion with a given momentum tends to preserve that momentum, changing it only when interfered with. Our name for the interfering agent is *force*. The amount of this force is to be measured by noting its effect upon the momentum. It is plain that a little interference long continued may have as much effect as an interference of greater magnitude for a briefer time. So we measure force by the *rate* at which it is able to change the momentum of bodies to which it is applied; and it is expressed numerically as momentum divided by time.

Now force may be applied momentarily; or continuously, through means whereby the point of application of the force moves with the mass to which it is applied. The blow hurts; but the push manufactures far more motion of the body receiving it, because the source of the force goes along with that body and continues to operate upon it. This ought to make it plain that we may properly define *work* as the product of the force and distance through which it operates. This does not mean the distance through which it moves its object. In a big gun, under ideal conditions of powder performance, a certain pressure (force) is developed against the base of the shell, and maintained by the continued expansion of the gases until the projectile reaches the muzzle. The work done is the product of this pressure by the length of the bore—*not* the product of the pressure by the ten or twenty miles of space through which the shell must travel, after it escapes from the application of the force and before atmospheric resistance and gravitational action have brought its velocity down to zero again.

Energy is the same as work. *Power* is something else. The work done in moving a mass of one ton through a distance of one foot is the same, regardless of whether the task be performed in a second or stretched out over a week. But when we cannot do this amount of work in a short time, moving the object rapidly, we have found that we may be able to do it in a longer time, by the interposition of levers, pulleys, gears, or some other device that slows up the rate at which our work takes effect. So we come naturally to the last term in the sequence: *Power* is the *rate* of doing work. It is measured as the work done, divided by the time in which it is done.

One paragraph addressed to the engineer and the mathematician. It is illuminating to express the sequence: *Velocity, momentum, force, work, power*, all in terms of the fundamental units for distance, time and mass. Following the discussion above, there will be no difficulty in understanding that velocity is D/T; momentum MD/T; force MD/T^2; work MD^2/T^2, and power MD^2/T^3. We need not apologize for the crudity of all the statements here made, or for the implication that velocities and all other rates are constant. If they are not so, the mathematician knows how easy it is to use derivatives in place of the simple quotients; and our statements expressing the more complicated quantities in terms of the fundamentals then become mere dimensional equations, of no numerical but of extreme conceptual significance.

Imported Coal and the Strike

NOT MANY of the people of the Atlantic seaboard cities are aware how much inconvenience, if not distress, they have been spared during the past few months of the strike, thanks to the large amount of British coal which has been imported. The total importation, when the last of it has reached our ports, will have been about 1,500,000 tons. During the recent British strike

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the same benefits in the way of keeping the gas and electric light and heat companies going were conferred by the equally large amount of coal which was shipped from the United States to Great Britain in the five months from April to August. It is a curious coincidence that the total shipment in each direction was approximately the same, the British receiving from us a total of 1,448,622 tons.

Of the total British importation two-thirds was steam and one-third gas coal; and the public of our eastern cities, and particularly of New York, are indebted to the enterprise of the importers, who, when the strike threatened, made arrangements for immediate shipments of coal on a large scale. These importations kept pace fairly well with the demands of our public utilities, and served to tide the seaboard cities over what threatened to be a most serious emergency. Had it not been for this, not only would city transportation have been very much curtailed, but the public would undoubtedly have been rationed during the past few months, both on electric light and on gas for cooking. The magnitude of the operations is shown in the case of a single well-known concern, which, early in July chartered every suitable ship that they could secure, and brought over, and are still bringing over, some 300,000 tons.

Something of what this means in the way of shipping is shown by the fact that to move this coal over 100 steamers were employed. About one-fifth of the total came over in American bottoms, and the balance was distributed among foreign flags, principally British. This was due to the fact that they had more vessels available that were built especially for coal carrying. Moreover, many British ships were coming this way for American grain. To bring a million and a half tons across the ocean, and handle and distribute it, was a bigger task than the public would suppose. In the first place America had never been an importer of coal, and, consequently, she was without the special coal handling machinery for the discharge of the vessels. Nor indeed had she the personnel experienced in the handling of coal from the ship to consuming points. Consequently, a large proportion of the coal had to be taken out by what is known as "diggers," or floating derricks, using buckets of only 2½ to 3 tons capacity—a very slow and expensive method, which could be tolerated only in emergency.

One advantage of this importation, both as regards America and Great Britain, is that the consumers on both sides have learned how to burn the imported coal to the best effect. The complaints which were heard on both sides of the water, that the coal was inferior, were due largely to unfamiliarity with the best furnace practice of the countries from which the coal was brought. Thus, British steam coals are lower in volatile content than some of our well-known grades, and, consequently, they require a stronger forced draft to give the best results. On the other hand, some of the high-volatile steam Scotch coals are if anything freer burning than similar grades obtainable here, and, therefore, require a slower fire. Some of our gas and electric corporations had the forethought to send engineers abroad to study the methods of burning particular grades of coal. These companies experienced but little if any trouble, and it was not long before all the users of imported coal were handling it satisfactorily. The same early troubles developed when the British began to use American coal, but they disappeared when they had made a study of our furnace practice.

The strike is over, and it is only a question of time when normal conditions will prevail; but it is to be hoped that the valuable experience which has been gained by the two nations will lead those who are at the head of our public utilities to make a careful record of this year's work and provide a tentative organization which will enable them, as soon as a strike becomes imminent, to commence the importation of coal on a large scale.

Are We to Have a Transcontinental Highway?

SOME months ago we mentioned the difficulties which the highway engineer meets under a change in political administration. A specific case now exists so glaring that we feel inclined to spread it on the record.

The Lincoln Highway Association and its aims are known to all and need not be discussed. The chief obstacle in the way of early completion of its project lies in the fact that Utah and Nevada are unable to meet the cost of that part lying within their borders. The association has always understood this, and always has held out special aid to these states. In particular, it conducted an engineering survey of all possible routes from Salt Lake to the civilized regions of western Nevada, to determine the best possible location in the light of the territory traversed, the local population, the available water supply, and all other pertinent features. The association has, of course, no slightest interest in any particular route save as such route may be shown to be the more advantageous; the competence and disinterestedness of its survey cannot be questioned. In fact the route laid down was accepted by both states, and an agreement reached that it should be improved as fast as funds were available. The association contributed considerable sums to both states; toward the cost of the work in Utah it has paid the state no less than $125,000, and this money has been expended by the state in the improvement of part of the agreed route.

Work was suspended in September, 1919, through temporary exhaustion of funds. Before it could be resumed a new Governor was elected by a new political regime. Later still, Congress passed the Federal Aid Act. Each state may now lay out a system of roads of interstate importance, to comprise at least 7 per cent of its total road mileage; and to the improvement of these designated roads the Federal Government will contribute. National aid goes up as local resources go down; in the cases of Utah and Nevada, by far the larger part of the total cost of the Federal Aid road system is borne by the United States.

It is in fact possible for these states to raise, at once, their own shares of the cost of the main lines in their Federal Aid highways. But the present Utah administration insists upon throwing out of the window all the work of its predecessor. In spite of contracts with the Lincoln Highway Association; in spite of the association's money that has been spent upon the previously authorized route; in spite of the fact that this route stands 80 per cent completed—in spite of all this the state refuses to designate the old route as part of its Federal Aid system. In its place has been nominated a longer route, crossing a wider and a drier desert, serving no local population at all—and coming out on the state line at a jumping-off place many miles from any connection with present Nevada roads or with roads which any sane Nevada administration would ever build. The very county (of Utah) through which this proposed road runs refuses to contribute a cent toward its construction.

We have seen no respectable reason advanced for this position on the part of Utah's authorities. The desire to discredit the previous administration has, of course, much to do with it. One sophisticated person has suggested that perhaps Utah isn't keen about good roads west of Salt Lake—that perhaps she would rather have the tourist spend his money in Utah than en route to the coast. Whatever Utah's motive, we have stated the facts; and there is but one possibility of changing this state's determination to hang up the Lincoln Highway program.

The selection, by each state, of its Federal Aid roads has to be passed upon by the Department of Agriculture. Secretary Wallace is the one person who can block Utah's announced intent of abandoning everything she has accomplished in trunk highway construction to date, violating her formal agreement, burning up $125,000 contributed in good faith by outside persons, and making it certain that no satisfactory connection between Salt Lake and the Golden Gate can be provided for many years. We hope the Secretary will decide that his powers were conferred upon him for just such a case as this; and that he will tell Utah, as gently as may be but as firmly as is necessary, that the aim of the Federal Aid Act is a national highway system, and not the promotion of peanut politics in the individual states.

Power Facts and Fallacies

OUR THIRD editorial this month covers a subject on which wide misconception and misunderstanding exist. Assuming this editorial to have been read and digested, we may pass from the rather special appeal with which it concludes, to address once more our audience as a whole. When the engineer comes to apply the principles which we have attempted to elucidate at the right of the facing page, the cardinal principle which he must keep always before him is that mechanical work done is the product of force—that is to say, in ordinary power production, of pressure—by the distance through which it exerts itself in producing motion. We have cited the case of the big gun. Similarly in the reciprocating engine, the work done is the product of the mean effective pressure (total, not per square inch) by the length of stroke.

An equally important factor can be appreciated if we examine the definition of power. Power, the rate of doing work, is work divided by time; and work, in turn, is force multiplied by distance. Power is accordingly force multiplied by distance and divided by time; but distance divided by time is velocity. So power may, alternatively, be represented as force multiplied by velocity. In other words, we may vary our components so that a smaller pressure applied at a very high velocity will produce the same result as a large pressure operating slowly—will do the same work in the same time.

In application this means that for a given unit pressure and given speed, we can gain an increase of total pressure and hence of power only by enlarging the area upon which the unit pressure is applied; and this in turn implies an increase in the size and cost of the mechanical plant. It is because of this that the engineer always aims to run his power plant at the highest speed consistent with the conditions.

A striking example of the operation of all these elements is seen on page 337 of our May issue, where a slow-moving pumping engine is contrasted with a high-speed torpedo-boat engine of the same power. The high-speed engine occupies but 80 cubic feet, while its slow-moving equivalent takes up no less than 728 cubic feet. In hydraulics we see parallel results when we consider the important part played by head or height of fall. A notable example was the single Pelton wheel shown on page 84 of our August issue, which develops 15,000 horsepower under a 1,008-foot head. If this head were reduced to 25 per cent of its original amount, there would have to be a proportional increase in the mechanical plant within the house.

It is because of the comparatively low head available that the various schemes for utilizing the power of the waves, or the tidal rise and fall, have proved so disappointing. To secure an amount of power comparable to that produced by a modern high-speed steam-engine or steam-turbine, or by a hydraulic plant operating under a great head of water, the tide-motor or the wave-motor becomes of such great dimensions as to render it, judged from the economic standpoint, quite impracticable. Thus the latest advices regarding the ambitious proposal to use the tidal power of the river Severn, in England, indicate that the enthusiasm for this great project has been materially damped because of the enormous size and weight of the hydraulic turbines which will be necessary on account of the limited head available. Fundamentally, the same trouble will present itself whenever an attempt is made to utilize the very limited rise and fall of the waves in a motor.

What Is There Left To Do?

Some of the Things that Agricultural Science Has Still Before It

By D. H. George

IN MANY respects agriculture has progressed during the last thousand years. Farm machinery and tillage implements have improved marvelously; unprofitable live stock have been eliminated by better breeding; improved systems of fertilization and crop rotation have increased the yields of the grains and cereal crops; our methods of farm management and marketing are on the up-grade; we know better how to utilize land. Yet so far as the fundamentals are concerned, in many respects we know no more than did the ancient Greeks and Romans concerning the why, when and where of plant nourishment and plant growth. This is in nowise a reflection on the ability of those who are wrestling with these complex riddles. It simply illustrates the immeasurable intricacies of agriculture, and shows that it takes hundreds and thousands of years to reduce many of these technicalities to an understandable and readily interpretable basis. If every agricultural scientist in the country solved but one of the countless problems of farming during his life, this almost endless research would only be well started. It will take centuries, and perhaps hundreds of centuries, to lay bare all these intimate secrets of Nature.

Using fire to eliminate insect pests—one of the hazards of crop production

According to Eugene Davenport, Dean of the Illinois College of Agriculture, the greatest future need of American agriculture is a fundamental national policy. One of our leading statisticians estimates that a century from now our population will amount to more than 225,000,000 people. The prophecy is startling because it suggests possible hunger and even famine as our future. At present, with less than half these numbers, our food production is only about equal to our domestic consumption. Unless we institute very revolutionary practices to enhance production, we may look for it to fall behind. Present indications are that we are rapidly slipping into the class of food-importing nations. This means that unless we are able to reverse the tide we must readjust our social, economic and industrial organizations to accord with this new condition.

THE farmers of early Rome and ancient Greece, were they restored to life and well-being, would be a trifle antiquated in their laboratory practice and farming logic. They would probably shy at tractors, look askance at milking machines, and dive back into the coffin on hearing the resonant explosions that accompany stump-blasting and land-reclamation projects of today. But once they had thoroughly brushed the cobwebs from their brains and become adjusted to modern apparatus and the ways of using it, the chances are that they would know almost as much about the fundamental facts of farming as our wisest experts. It is by way of showing that modern advance over ancient models has been largely in tools and machinery, and that there is all the room in the world for successful examination of the whys and wherefores of crop production, that Mr. Dacy, with the cooperation of numerous authorities on the subject, has compiled the accompanying statement of just where modern agricultural science is trying to go and how far it must travel to get there.—THE EDITOR.

American farm crops now occupy the major acreages of all the easily reclaimable land in the United States and our future increases in food raising must come from the more intensive utilization of the land now available. There are no large tracts which have not already been introduced to the civilizing influences of the grubbing hoe and the plow. In intensity of culture, we must take a few more lessons from our European neighbors. Although per farmer, we produce four times as much as they do, when it comes to a matter of total yield per acre, our average returns are 50 per cent short of those of overseas soil-tillers. The problem before us is to approach the European per-acre performance, without approximating the dehumanizing methods of tillage by which Europe makes this showing at the expense of the agricultural laborer.

Dr. E. D. Ball, Assistant Secretary of Agriculture in charge of scientific research activities, reports that Uncle Sam is going to do everything in his power to increase the efficiency of American farming. Profound studies of the relation of different soil factors to plant production are essential; investigations must be made concerning the water-holding capacities of soils, the activities of bacterial flora, the most satisfactory methods of rendering plant nutrients available, methods of aerating soils and ways of eliminating the enigmas from peculiar physical properties of various soils. It is also paramount that improved systems be devised of protecting certain soils against leaching and of armoring other soils against the baking effects of the burning sun. The fertilizer requirements of soils have been studied for centuries, yet there is still much to investigate along these lines. Furthermore, the fertilizer resources of the country must be surveyed and effectualized. Most recent information is that 75 per cent of our most important commercial fertilizers will come from Germany and 25 per cent from France during 1922. This means that our potash industry, which found inception during the war period, will be practically ruined unless government intervention saves it.

American animal industry is improving constantly, although slowly, as a result of the use of better breeding stock and the practice of approved systems of feeding and management. Remarkable results have already been obtained in the prevention of animal tuberculosis and cholera. It may be that the coming century will devise methods of saving cattle, hogs and poultry already afflicted with these insidious and infectious diseases. The standardization of biological products such as serums, vaccines, bacterins and aggressins may also be effected.

The introduction of superior types of foreign live stock is also doing much for our production resources. For example, the water buffalo as producers of edible meat have been introduced successfully into the southern states. In that section these animals prosper wonderfully well and are resistant to the damages wrought by the Texas fever tick. The introduction of Karakul sheep for the production of the valuable Persian lambskins is another memorable accomplishment. It is anticipated that such importations will be expanded greatly in the future.

The introduction of new and foreign plants which give promise of profitable production under American conditions is an activity which potentially may markedly increase our food production. The navel orange was brought into this country in this manner and has led to the development of a most successful business in citrus fruits. The honey dew melon industry was developed in a similar manner. Hundreds and thousands of new plants, forages, grains and fruits are brought to the United States and tested out under local field conditions by the government experts. Those that thrive are accepted and added to our schedule of acclimated and satisfactory products of plant industry. Russian Durum wheat, Peruvian and hardy Siberian alfalfas, Japanese rice, Egyptian and other cottons, Sudan grass, Napier grass, Rhodes grass and many varieties of sorghums, oats, barley, soy beans, avocados, mangoes, dates and pistaches were introduced in this manner.

One of the big advancements of the future, unquestionably, will be the elimination of certain hazards of production which heretofore have jeopardized various agricultural enterprises. Although foot and mouth disease has been introduced three times, our efficient government forces turned back the invader on each occasion. Most of the European countries have to contend with this pest which takes the profit out of stock farming operations. Area clean-ups of bovine tuberculosis will be one of the important works which Uncle Sam will feature in the future. Barron County, Wisconsin, is the first area in the country to attempt such a campaign. That county is now free of the infection and the earnest desire of the Department of Agriculture is to extend these beneficial eradication campaigns to every other county in the country.

Only recently the government experts have been successful in ridding Florida citrus fruit groves of canker disease which formerly exacted heavy annual tributes. Future attempts will be directed toward eliminating the pink boll worm—one of the most destructive parasites which preys on cotton—from the southern states where it now occurs. Uncle Sam may even win success in ultimately routing the boll weevil from Dixieland and in subduing the ravages effected by ox warbles, the modern freebooters of the leather industry. During the next five or ten years the scientists plan on eradicating this plunderer that annually accomplishes millions of dollars damage to our beef cattle and leather industries. One-third of all the hides which appear on the Chicago market are blemished with ox warble injuries, and this loss is quite typical of those which obtain in all other market centers of the country.

Examining incoming plants for fungi and insects at the horticultural Ellis Island

At this writing, there are more than 50 serious plant disease and insect pests which are parasitic, in one form or another, on the American economic farm crops. The black stem rust of wheat is an excellent illustration of what vast amount of damage can be accomplished by minute marauders, in many instances too small even to be visible to the naked eye. During a recent year, this wheat pest caused a loss of 200,000,000 bushels of wheat at a time when the price of this farm crop was at a peak point. Eleven

of the leading wheat growing states of the Upper Mississippi Valley are now engaged in a drastic siege against this crop despoiler. They are eradicating the barberry bushes which are host plants that protect the rust during a delicate stage of its annual life cycle. Ten years from now, this source of wheat injury may be under control. The codling moth collects a yearly toll of from 10 to 20 per cent of our pear and apple crops. Last year, it ruined approximately 6,000,000 barrels of apples alone. One of the outstanding agricultural achievements of the future will be to curtail and, if possible, to control such losses.

The future utilization of our farm land areas which may be made available by reclamation or drainage must take cognizance of the relative value of the land for food production or for other purposes. For example, such questions as whether it would be preferable to drain a given swamp and convert it into farming land or to develop its aquatic resources and utilize it as a production center for food fish and other aquatic food products must be worked out. It is essential that we protect our fish and wild fowls and provide them with suitable regions of permanent abode. Hundreds of thousands of acres of lowland have already been drained which would have been much more valuable—from a potential food production standpoint—if they had been left as swamps and devoted to aquatic food production. As a result of the overpractice of land drainage, the water table of the state of Iowa has fallen from 10 to 12 feet during recent years. The condition has been reached where moisture famine threatens Iowa corn farmers during a droughty season. And what is true of conditions in Iowa also has wide application over the entire Corn Belt.

When Congress rotates again into an attitude of philanthropy and benevolence so far as appropriations for scientific research are concerned, it may be that the United States Weather Bureau, a branch of the Department of Agriculture, will be allotted enough funds so that it can tackle some of its prize problems. One thing the weather experts will try to consummate before 1950 rolls round will be a more comprehensive extension of observations in the free atmosphere, even including the atmosphere over the oceans. Only rudimentary investigations of this character are now in progress. A decided extension and expansion of this work would be of great fundamental value in the advancement of meteorology in all its lines, because it will provide a more detailed knowledge of systematic conditions in the free air up to greater heights than is possible to procure from research now in progress.

Another problem which Professor C. W. Marvin of the Weather Bureau is anxious to solve is the determination of the causes and origin of the great primary cyclonic and anti-cyclonic systems which are described on the weather maps from day to day, including, particularly, the somewhat freakish phenomena of West India hurricanes which are tropical and low-latitude storms of intense violence and destructiveness. The weather scientists believe that a more intensive study of this enigma by means of soundings of the free air and observations with pilot balloons in the tropical regions will contribute much helpful information in regard to these abnormalities.

Another matter of special concern which as yet has been accorded but a small amount of attention is the study of relations between the phenomena of terrestrial weather and possible changes in the intensity of solar radiation, which are regarded by scientists as the ultimate cause of all unusual weather conditions. Despite many assertions which have been made repeatedly that marked changes occur in the intensity of solar radiation from day to day, the Weather Bureau questions this, and has recently inaugurated an intensive study of past observations of this character, with a view to ascertaining quantitatively the possible amounts of variation which may be justly ascribed to true solar origin. In these experiments those variations which are caused by the influences of the earth's atmosphere on the observations are being eliminated from the records.

During the next century the plant experts of the national Department of Agriculture will doubtless be absorbed in unraveling such scientific knots as those connected with the investigation in foreign countries of plant diseases which affect either the same or closely related crops in this country. They also will strive to discover and introduce into this country species, varieties and strains of plants which display the power of immunity that enables them to resist diseases and other enemies. Much of their research will relate to plant nutrition studies, including fertilizer investigations correlated with crop rotation investigations having for their object the discovery and application of knowledge about the effect of plant foods on crop yields, quality and keeping powers of plant products, resistance to diseases and other enemies, and the relation of successful live stock production to the presence or absence in the soil of certain mineral constituents. Complete field studies of plant hygiene will also be instituted, including studies of the relation of crop plants to borax-contaminated soils, the elimination of cumulative soil pests like crowngall and nematodes as well as nation-wide surveys looking toward a satisfactory system of forecasting outbreaks of plant disease.

Italian broom infested with corn-borer

Forestry is a branch of agriculture. Passing over the burning question of conservation, we need a chain of forestry experiment stations in the timber regions of the eastern states so that precise, scientific knowledge may be accumulated concerning their specific requirements. The forestry problems of different sections of the country are as different as are the farming difficulties. Although there are eight forestry experiment stations in the western United States, they cannot investigate the local perplexities of eastern timber owners. In only one way can the facts and figures relating to eastern forestry puzzles be obtained and that is by the early establishment of forestry research stations in eastern woodlands. Such stations should be located in the Lake States, in New England, Pennsylvania, in the Southern Appalachians and in the southern pine belt.

One of modern forestry's crucial problems is the prevention of fires

Fantastic though it may seem, the prediction that wood may be used as human food before the twenty-first century arrives is backed up by sound, scientific facts. That is why the Federal Forest Service is planning investigations of the nutritive properties of wood. From a theoretical standpoint, the conversion of wood cellulose into starches capable of being assimilated as human food is entirely practical. It has already been demonstrated that wood can be converted into grain alcohol. The actual manufacture of grain alcohol from wood for use in the arts is now under headway. Experiments of the Forest Service in the production of cattle feed from hydrolized sawdust have reached a stage prophetic of a favorable outcome. It may be that our forests will prove of future value as a source of food supplies not only for live stock but also for human beings that will be revolutionary almost beyond the possibility of forecast at the present time.

The permanency of soil fertility may be definitely determined before 2000 A. D. It may be that expeditions of American experts will be sent around the world to make soil investigations and soil maps of small areas around the old centers of civilization such as Paris, Madrid, Rome, Athens, Constantinople, Pekin and Tokio in order to compare the composition of such soils which have been occupied for agricultural purposes for the support of mankind for thousands of years with similar types of soil in the United States. These explorations may also be extended to Africa, South America and British North America to find types of soil as nearly as possible identical with those known in this country that have never been occupied by the human race nor been subject to any cultural methods whatever. Such expeditions would probably settle the questions propounded two to three thousand years ago by the Greek and Roman philosophers, and which are still unanswered today, as to how long our soil productivity is likely to last.

The United States Bureau of Entomology during the next half century may institute comprehensive investigations of natural control of insect pests, including the establishment of laboratories in foreign countries for studying and introducing into the United States parasites and other natural enemies of destructive insects. Explorations and investigations of injurious insects in foreign countries may be undertaken as a basis for plant quarantine measures and to safeguard the plant introduction activities of Uncle Sam. Continuation will be made of the destructive forest insect studies, such as the bark-beetles which have preyed upon the coniferous forests of the West.

In addition to continuing its persistent campaign against predatory animals which prey on domestic live stock and farm crops of the western states, the Bureau of Biological Survey desires to determine the economic relations existent between reptiles and amphibians. Certain reptiles and amphibians feed largely upon injurious insects and rodents, while some of these same reptiles are exceedingly destructive of useful birds. Complete data is needed to determine the economic value or injuriousness of the different species. Doubtless the government specialists will extend their experiments in the domestication and successful propagation of game birds, including both waterfowl and upland varieties. They also will expand their experimentation in the introduction and breeding of certain fur-bearing animals in this country, as such operations furnish the possibility of successful increase in farm production. The resources of the fur markets of the world annually are approaching exhaustion and shortly there will be a startling demand for the comfortable overcoats of animals raised in captivity. There are many fur-bearing animals almost as valuable as black foxes, skunks and other erstwhile wild beasts which have not yet been raised under domestication for such purposes but which will be on a large scale during the next century.

Durability of Cement Drain Tile and Concrete in Alkali Soils

TECHNOLOGIC Paper No. 214 of the Bureau of Standards is the third progress report to be issued on the investigation of the durability of cement drain tile and concrete exposed to alkali soils and waters. It gives an account of the condition in 1919 and 1920 of experimental drains laid in western alkali districts in 1913, and of large concrete blocks similarly exposed in 1915. Both drain tile and concrete blocks were made up in sufficient quantities and variety to be representative of all qualities, and were placed in typical alkali sections of the arid belt from New Mexico to Montana.

The paper gives tentative conclusions concerning the use of these materials, and also carries two appendices, one containing a summary of the absorption tests on samples of all types of drain tile used in the investigation, and the other a discussion of the occurrence of soluble salts in the soil, and their action on cement and concrete. This paper may be obtained at 10 cents per copy from the Superintendent of Documents, Government Printing Office.

The Pulitzer Trophy

A Race of Radiators, Wires and Landing Gears

By Archibald Black

Consulting Aeronautical Engineer

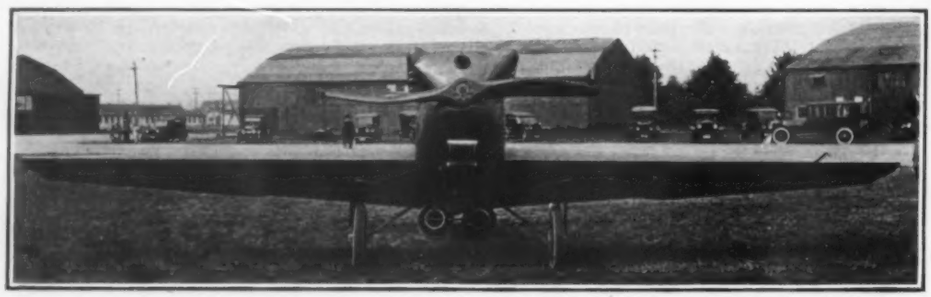
THE PULITZER Trophy Race, held in Detroit on October 14 last, was responsible for some of the most interesting developments in airplane design of recent years, as well as for some amazing speed records. Speeds of 206 miles per hour throughout the race and as high as 220 miles per hour in straight stretches were made. The end does not appear to have yet been reached, and it is probable that the next race will witness even higher speeds. The race finished as a thorough American triumph, several world's speed records being brought to this country by American pilots flying Curtiss airplanes with Curtis engines, and of American design and construction throughout.

Army Curtiss thin-wing biplane in which the wind resistance has been brought down to a minimum

Airplane races of this type are developing into struggles to decrease air resistance still further. Little is gained now by further increase in engine power. This was shown by the fact that the airplanes making the fastest time in the race had only two-thirds the horsepower of some other contestants which did not approach their speed. Accordingly, it seems logical to expect that further pushing up of speed records will be more dependent upon increased refinement of airplane design rather than upon the development of larger engines. At the same time, it should not be taken for granted that the engine size will not increase in the bargain.

From the technical viewpoint, the machines in the race possessed several features of considerable interest. Possibly the most important of these were the wing-surface radiators, with which the winning Curtiss machines were equipped, and the retractable landing gears with which some of the other fast machines were furnished. The wing-surface radiator is the last word in the reduction of radiator resistance and it is practically impossible to go further along this line. Using, as it does, the surface of the wing for radiation, radiator resistance is almost totally eliminated by being reduced to the slight difference between that of the smooth fabric and the corrugated metal. One of the accompanying photographs shows the winning Curtiss machine, and the radiator plates can be seen on each wing between the center of the machine and the strut. These radiators consist of two sheets of brass soldered together, the inner one being flat while the outer one is corrugated. The corrugations thus form channels through which the water flows, the channels being so arranged that this flow is fore and aft of the wing. The water flows back through one surface and returns forward through the other, distributing pockets being provided at the front and rear edges of the wings. The general principle of this radiator is not new, but it was never perfected and put into practical use until developed by the Curtiss organization during the past two years. Curtiss engineers estimate that its use increased the speed of the winning airplanes by about 15 miles per hour and, now that its success has been demonstrated, it promises to come into general use in racing airplanes.

Landing gear chassis with wheels which can be drawn out of the wind, or "retractable chassis," as they are generally termed, were used on the Verville-Sperry and on the Bee Line Racer machines. This is a development which is not entirely out of the experimental stage, but promises to decrease resistance still further. There seems to be no doubt that it added to the speed of the machines equipped with it. In each of the types just mentioned the wheels are designed to fold together into the lower surface of the wing, where a recess is provided to receive both wheels and struts. With the whole landing gear folded up, the bottom surface of the wing, in each design, was somewhat broken up where the irregular-shaped parts fitted into the recess. No doubt future designs will be so arranged that the folded chassis not only folds up, but also closes the recesses into which it fits. Where speeds of around 200 or more miles per hour are concerned, every little disturbance of air flow becomes quite serious, and even the slightest detail cannot be neglected.



Verville-Sperry thick-wing monoplane which did not match the speeds of the thin-wing biplanes

Another interesting feature of this race was the competition between two schools of airplane design, each of which has had its enthusiastic exponents for years. This was brought about through the entry of several thick-wing monoplanes and several thin-wing biplanes in the race. Just which is the most satisfactory for high speed is not yet settled, although the race was won by the thin-wing biplanes. Thick-wing machines made a good showing, considering they are a later development and it is quite possible that their speeds may be further increased in future designs. In comparing thick- and thin-wing machines, aeronautical designers follow the practice of testing models of each in wind tunnels and basing their calculations upon the results of these tests. However, the tests are made upon very small models and at speeds of 40 to 60 miles per hour, while the full-sized machines now fly at over 200 miles per hour. So far, we have never been able to determine just how great is the error in these calculations, nor can we say whether this error is the same for the thick wing as for the thin one. The National Advisory Committee for Aeronautics is constructing, at Langley Field, Hampton, Va., a compressed-air wind-tunnel which may settle this question. In this tunnel the wind, instead of being about normal atmospheric pressure, will be compressed to pressures ranging up to 300 pounds per square inch. Tests made in this tunnel will eliminate a large part of the error from present calculations.

One of the interesting types of machines which took part in the race was the Thomas-Morse all-metal monoplane. All-metal airplanes are by no means new, but this is the first high-speed machine to be built of metal throughout. While ranking among the slower airplanes in the race (if any machine making 165 miles per hour can be so referred to), it was of interest as marking the entry of the metal type into the racing class. With continued development and refinement, this type may become more common in racing, although much work remains to be done on it before it can compare with the more conventional constructions. Another contestant in the race, the Loening monoplane, had a radiator mounted on the nose of the fuselage, a practice which had become very unusual in high-speed machines. Nevertheless, this machine made about 170 miles per hour around the course.

Still another interesting feature of the machines in this year's race was the number of those which partly or wholly eliminated cloth wing covering. The wing surface radiators provided a rigid metal surface while, in other cases, the surface was wholly or partly of plywood. The Thomas-Morse all-metal machines were surfaced with corrugated aluminum-alloy sheet. Thus a large number of the machines entered had one type or another of surfacing which was more or less rigid. With speeds over, or even approaching, 200 miles per hour there seems little doubt that the use of cloth surfacing is less advisable than it ever was, and that ultimately it may be prohibited altogether by speeds which, once beyond the wildest dreams, are now within the realms of constructive forecast.

The Pulitzer Race uncovered another interesting tendency in the effort to eliminate every little cause of resistance—the increased use of covers on the hinges of rudders, elevators, and other controls. Formerly this hinge was left uncovered thus exposing a slot opening to the wind. Now that we have reached speeds where the slightest loss in efficiency or increase in resistance is greatly multiplied, no detail of this kind is escaping attention. The hinge slot on most of the machines in the race was covered with either rubber sheet or a metal plate to prevent leakage of air through it, and this is far from trivial at 200 miles per hour.

Navy Curtiss thin-wing biplane which follows more or less the same lines as the Army Curtiss machine

Forty years of Michigan Central locomotives. The super-locomotive No. 8000, with the very last word in accessories and refinements, compared with the small locomotive of forty years ago and still doing light hauling around Detroit

A Super-Locomotive With the Latest Improvements

LOCOMOTIVES, like automobiles, have their accessories. But while the average automobile owner is always ready to add one more accessory to his already heavily adorned car, the railroad companies are very slow and very cautious in considering accessories for their locomotive except after those accessories have proved to be of surpassing value in actual operation. Even then, the cost has a deterrent effect, so that most locomotives operate year after year in their original plain shape.

Somewhat unusual and most commendable, therefore, is the recent experiment of the New York Central Lines. An extraordinary locomotive, No. 8000, which is expected to prove a most important contribution to motive power progress, has just been put in service on the Michigan Central Railroad of that system. No known accessory or technique of established value has been overlooked in the construction of this super-locomotive, which has now made its appearance from the locomotive shops in Lima, Ohio, and is ready for heavy freight duty at Detroit.

The new locomotive was planned and constructed under the personal direction of President A. H. Smith of the New York Central Lines, who specified the several most important main accomplishments to be sought by the new design and made provision for the use of every up-to-date improvement of proved worth, brought to the last degree of refinement for economy and efficiency. The engine is of the Mikado type, but, of course, contains numerous features never before incorporated in any locomotive.

In its initial road test, No. 8000 hauled 100 heavily laden coal cars and later easily pulled a train of 140 cars containing more than 9,000 tons of coal, indicating a capacity of more than 150 cars and a load in excess of 12,000 tons. In marked contradistinction, a great stir was caused at Detroit when one locomotive hauled 13 box cars loaded with stoves upon the opening of the Michigan Central Belt Line on October 3, 1888. Yet here is No. 8000, 34 years later, with its marvelous performance far in excess of all expectations.

Now we are ready to get down to specific details as to the accessories and improvements incorporated in No. 8000. First of all, there is the "booster"—a separate pair of steam cylinders and driving rods which convert the usual trailer wheels, placed under the cab, into driving wheels. This feature when in operation, is said to give the locomotive a 26 per cent increase in power over the usual drivers, and is invaluable for quick starting and for grades. When the train is well under way, the booster is not in use.

Superheated steam is used to operate the air pump, booster engine, feed-water pump, and the headlight turbo-generator. Instead of the customary injector, a feed-water pump takes the water from the tender and forces it through a heater into the boiler, the heat for the heater being obtained from the exhaust steam, the condensate of which is returned to the tender through a filter, which eliminates any oil that may have been carried over from the cylinders into the exhaust steam.

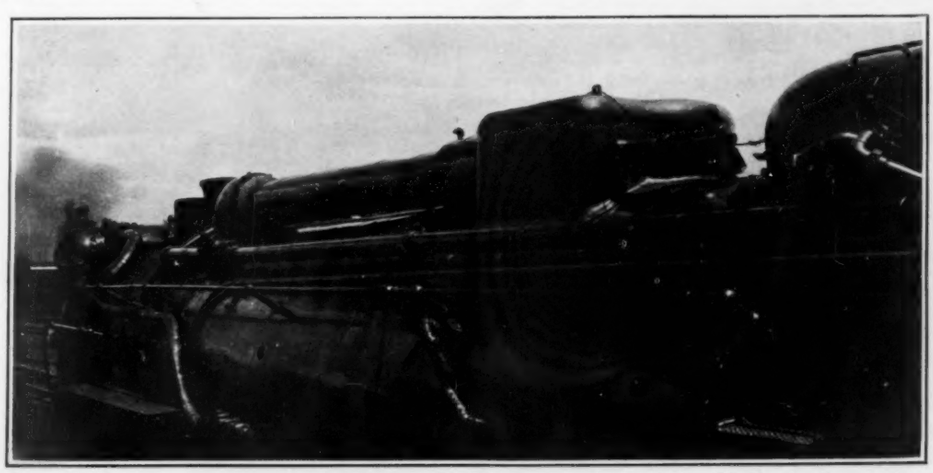
The feed-water heater is located at the front of the engine above the headlight and near the top of the boiler, on a level above the top of the tank so as to give the condensate pipe line plenty of fall to return the condensed water to the filter on the rear of the tender. The feed-water pump is mounted just back of the left side of the smoke-box on the boiler.

Another important departure from standard railway practice is the feature of superheating the steam before it reaches the main throttle. In this locomotive the steam from the boiler passes through the steam dome into the dry pipe and thence to the superheater units, the dry pipe, which is outside of the boiler, being connected at the forward end direct to the superheater.

Before the steam leaves the dome it passes through a separator which collects any water that may be carried in the steam, the water being automatically returned to the boiler, which, together with the taking of steam from the highest possible point of the boiler, insures absolutely dry stream of unusually high temperature. From the superheated steam passages in the header, the superheated steam is conveyed to the throttle, the location of which is in what might be termed a throttle box, which is on top of the smoke box and just forward of the smoke stack, forming another unusual departure from existing designs and practice, and being calculated to get the steam to the cylinders from the throttle in the most direct way possible.

Careful attention has been given to the application of devices to facilitate handling the locomotive by enginemen, the special equipment consisting of power reverse gear, automatic stoker and an automatic grate-shaking device, which shortens the time the engine must spend over ash pits. The interior arrangement of the cab is such that the engineer and fireman perform the necessary duties in connection with the operation of the engine, with minimum of movement from their positions on either side of the cab and with the physical effort of each being practically nil. Even the blowing of the whistle is pneumatically operated, an air valve being located near the side of the cab and immediately in front of the engineer. As is customary on the Michigan Central, the engine is equipped with water scoop, which eliminates stops and consequent delays for taking water.

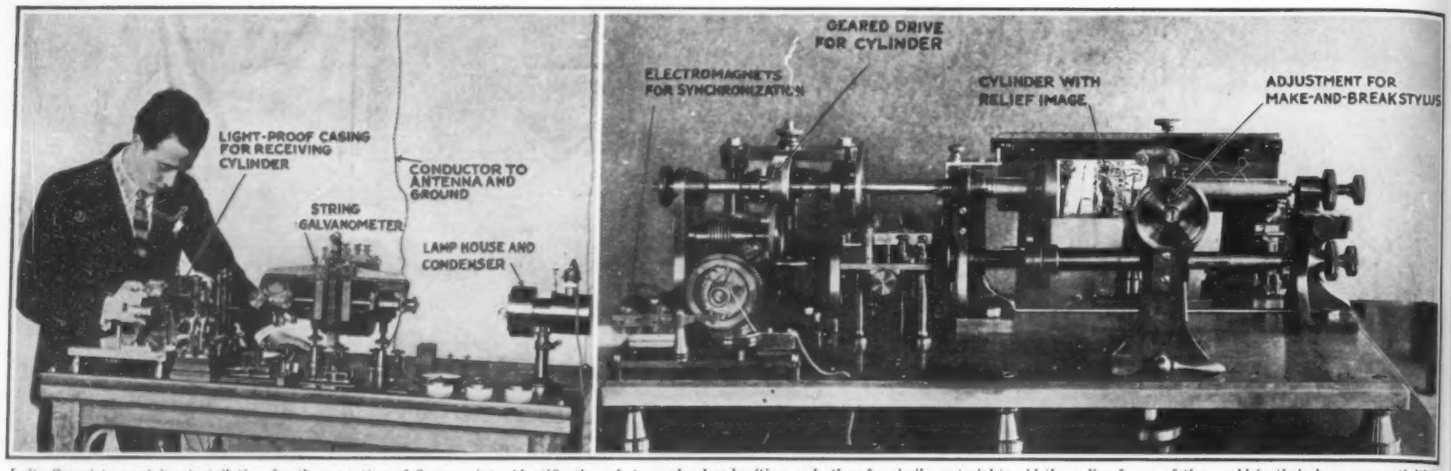
Summed up, this super-locomotive is the last word in efficiency and economy in freight motive power. Its three principal claims are: (1) For its weight, it will deliver more power than any locomotive in the world. (2) It will exert more tractive effort per ton of coal consumed than any locomotive ever built. (3) It will prove a locomotive easier to operate and repair than its predecessors, this making for quick turn arounds and safety.



Close-up of the super-locomotive, showing the placing of many parts outside of boiler to give greater accessibility for making repairs and adjustments

Bud Mutations

THAT bud sports, or bud mutations, frequently give rise to important new varieties has long been known. Darwin studied many such cases. Mr. A. D. Shamel, in a recent publication of the Experiment Station of the Hawaiian Sugar Planters' Association, describes and clearly illustrates many modern instances, and concludes that in many plants the selection of bud mutations is quite as important as seed selection in the origination of new varieties. Such occurrences are notoriously frequent among citrus fruits, where many often occur on the same tree, but they are also relatively common and have given rise to new varieties in the case of potatoes, sugar-cane, most fruits, and a great variety of cultivated garden-plants. Less is known concerning the frequency with which they will come true from seed, and this, of course, lessens their evolutionary significance.



Left: Complete receiving installation for the reception of finger-prints, identification photographs, handwriting and other fac-simile material to aid the police forces of the world in their long-arm activities. *Right* Close-up view of the transmitting mechanism for the transmission of finger-prints, handwriting, drawings, maps, or other black-and-white or "line" images

Receiving and sending ends of the new long-distance identification system of the modern police

Finger-Prints via Radio

Enlisting the Long Arm of Radio in the Search for Europe's Malefactors

DAILY, the path of the criminal becomes narrower and more difficult. Aside from the excellent police forces throughout the world and their active cooperation, the criminal is confronted by the keen inventive mind which is adding more and more obstacles in his path and making his identification and capture more and more certain. The latest obstacle thus placed in the path of the wrong-doer is the long arm of radio, which not only serves to ensure rapid intercommunication of news and notes between the various police forces of the world, but also transmits photographs and finger-prints of the wrong-doer for the purposes of instantaneous and positive long-distance identification.

A portable transmitting outfit which can be attached to the usual telephone or telegraph line after the necessary arrangements have been made for a clear right-of-way communication

With the police official in the field

The means employed for the transmission of photographs and drawings via telegraph and telephone line, as well as by radio, have been described in past issues of this journal, at the time when the inventor, Eduard Belin of Paris, succeeded in transmitting photographs between St. Louis and New York by telegraph line, and between Bordeaux and Bar Harbor via radio. Much the same means are now employed in the transmission of identification photographs and finger-prints between various European cities in an experimental capacity, although it is certain that this long-distance identification must ultimately come into general use.

Briefly, the Belin system of image transmission operates as follows: An image, in the form of a photograph, drawing, handwriting, printed matter or finger-print, is converted into a relief image and wrapped about a cylinder of the transmitting device. Then, as the image turns at a predetermined speed which is in absolute synchronism with the turning of a receiving cylinder at the distant point, the high and low spots of the relief image are brought in due time under a point or stylus of a current-controlling device. In the case of photographs, where a half-tone effect must be handled, with blacks, whites, and the various intermediate values, the stylus is connected with a microphonic instrument so that the varying pressure on the carbon grains of the microphone control a current quite in keeping with the relief effect of the image. In the case of straight black-and-white or "line" images such as handwriting, drawings, finger-prints, maps, printed matter and so on, the stylus is connected to a simple make-and-break device, which makes and breaks a current according to the raised or the lowered portions of the image passing under the transmitting stylus.

So far so good. We have, then, a local current which is modulated or varied in accordance with the plain black-and-white or even the half-tone values of the image to be transmitted. This local current can be sent over the usual telegraph or telephone lines, or impressed on a radio transmitter through suitable relays or modulators.

At the distant receiving station, the modulated current in the form of a current from a telegraph or telephone line, or again the weak energy from a radio receiving set, is brought to the strings of a highly sensitive galvanometer. The strings of the galvanometer respond to the varying strength of the incoming impulses, and vary a beam of light accordingly. The beam of light, in turn, makes its varying impression on a piece of sensitized photographic paper or sensitized film wrapped about a revolving cylinder and contained in a light-proof casing. Thus, while the transmitting stylus is passing over the relief image in a path that resembles the thread of a machine screw but with the turns very close together, or not unlike the grooves of a cylindrical type phonograph record, the beam of light at the receiving station is being impressed on the sensitized paper or film in a corresponding helical path.

Space does not permit a complete description of the Belin apparatus. The receiver is slightly altered when changing over from photographic or half-tone reception to plain black-and-white or "line" reception. The full details of the Belin system may be obtained from our issue of November 6, 1920.

The transmission of photographs by the Belin system calls for the preparation of a relief image of such size as to meet with the requirements of transmission and final use. The photograph to be transmitted must be copied to the desired size and then made into a relief print. In the case of facsimile handwriting, however, the copying process might well be eliminated in order to obtain a more direct reproduction of the actual handwriting, as well as avoid much loss of time and considerable trouble.

Some time ago Mr. Belin called on the SCIENTIFIC AMERICAN for assistance in this matter of converting handwriting, finger-prints and other images into direct relief images. Various methods were considered, but the most promising one has been found in the use of special inks and powders which are now employed by printers for the production of imitation engraving and embossed stationery. The handwriting, finger-print, printed matter or other image is produced with the special ink, and the wet image is then sprinkled with the special resinous powder. The surplus powder is blown off and the image is then placed in an electric oven for a short time in order to bake the powder, which turns into an enamel-like relief image. This relief image, on the proper sized sheet of paper, is ready for the transmitter cylinder without the usual copying and developing and printing process. In the case of finger-prints, the criminal is called upon to make the prints with the sticky ink, and the prints are treated directly to form relief images.

The latest reports from Mr. Belin are to the effect that the inks and powders which we have obtained for him are working out satisfactorily and appear to be the solution of his problem. Furthermore, he has found the powders quite satisfactory even with the usual writing inks. Thus the process in no way differs from that of ordinary handwriting.

To what extent the Belin system may be employed in the apprehension of criminals is difficult to predict at present. However, this ready means of transmitting photographs and handwriting and finger-prints and other identifying details must prove invaluable in the interchange of information between the police forces of the leading countries. At present such information requires days and weeks to be transmitted, during which time the criminal at large has plenty of time to maneuver to his own advantage while the police hardly feels justified in detaining him for so long a time on mere suspicion. Radio and telegraph lines, radiating to every corner of the globe, are now available for the transmission of definite identification data as well as the power of the law. This application, for the present, seems to eclipse the news photography phase of the Belin system of image transmission.

Actual finger-print record received with the Belin apparatus. The inscription reads: "Beg to let us know if finger-prints above are surely those of No. X-23495"

Long-distance evidence: Finger-prints via radio

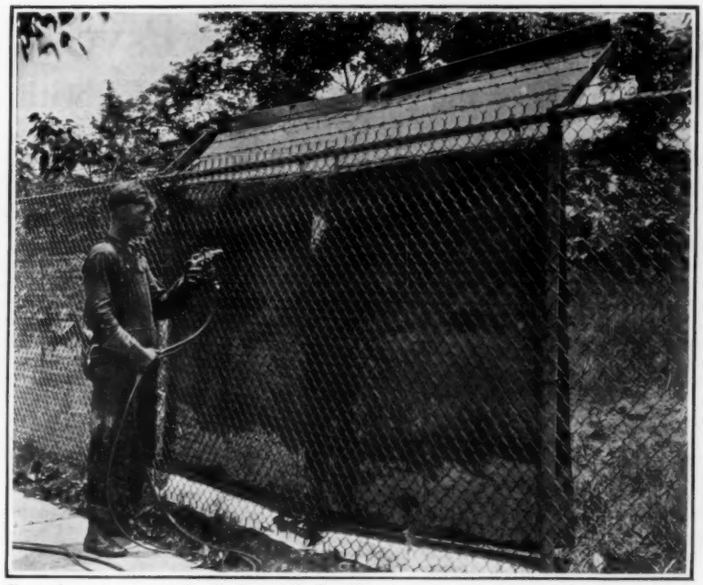
Painting a Wire Fence Without Waste of Paint

IT has remained for an American manufacturer of machinery to work out a method of painting woven wire fences with a minimum of labor and waste. In the first place, the paint is sprayed on, which is entirely in keeping with present labor-saving practice. Then it is claimed that much less paint is used than if a brush were employed; and again, the paint coat is thicker and affords better protection.

Spraying paint on to the wires of a woven wire fence is one thing, and the wasting of paint is quite another. Ordinarily, such spraying would mean a great waste in paint, for such paint as did not adhere to a wire would go some distance beyond and fall on the ground as so much waste. Now the present method takes into consideration the usual waste of paint, and not only does it eliminate this waste but it enables the worker to paint both sides at one operation.

It will be noted that the wire fence is painted at an agle of 45 degrees, and that the side toward the pneumatic gun is painted very easily. The shield at the back of the fence causes the spray to rebound and paints the side of the fence opposite the gun. The paint that does not get on the fence flows down the shield into a gutter provided at the bottom and is drained into a pan where it flows back into the tank, there to be used over again.

When woven wire fences are painted with brushes it is necessary to make the paint very much thinner than the manufacturer provides it, because it is usually so thick that it would wear a man out dragging it across the mesh, not to forget the rapid wear on the brushes. With the present pneumatic spray method, however, the paint need not be thinned beyond the point at which it will drain properly off the screen.



Spraying a woven-wire fence on both sides in one operation, without waste of paint, by means of the shield here shown

Radiators for Aircraft Engines

THE Bureau of Standards describes in Technologic Paper No. 211, available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 50 cents per copy, the extensive investigations which it conducted on radiators for aircraft engines during the World War. Reports based on nearly all this work were issued by the National Advisory Committee for Aeronautics at the time the various investigations were completed, but it has been considered advisable to go over all the data, carefully revising it in the light of present experience and upon this basis to prepare an entirely new report dealing with all the work in uniform style. Necessarily many of the earlier reports which were issued because of the special urgency of the work did not treat the subject as fully or as thoroughly as can now be done with the greater experience at present available.

Any one interested in this work should, therefore, find the new report of particular value and should use it in preference to any of the earlier ones. The testing methods employed at the Bureau are described and formulae are given for the design of radiators. The results are based on tests of 66 different types of radiator cores, and the investigational work has covered practically every condition which might be met with in service.

The Last Word in Fire-Fighting Boats

PROTECTING the ships in the harbor with their thousands of passengers and millions of dollars worth of cargo is, of course, the main job of New York's fire-fighting boats. Then there is a secondary job—that of fighting fires at piers and buildings near the water front, in collaboration with the land forces of the fire department. And at all times, under all conditions, the fire-fighting craft must be ready to go into action without loss of time. Minutes count in this work. From a standing start, the fire-fighters must get into full action at a moment's notice.

A 600-mile coast line around Greater New York must be covered by the fire-fighting boats. The New Jersey coast line must also be covered, since the assistance given on the Jersey side is a cooperative precautionary measure. The port cities of New Jersey do not happen to possess powerful fireboats, and the hazard of a burning ship breaking loose from a pier or anchorage and floating down the Hudson River with serious danger to shipping, is a possibility which interests New York sufficiently to get into action even outside its territorial waters.

Eleven fireboats comprise the Marine Division fleet of the New York City Fire Department, and they are the most powerful craft of their kind in the world. Well might any city be satisfied with such fire equipment; yet the demand for prompt action, together with still more powerful streams of water, has prompted the officials to challenge the continued use of the usual reciprocating pump. And thereby hangs the story which follows.

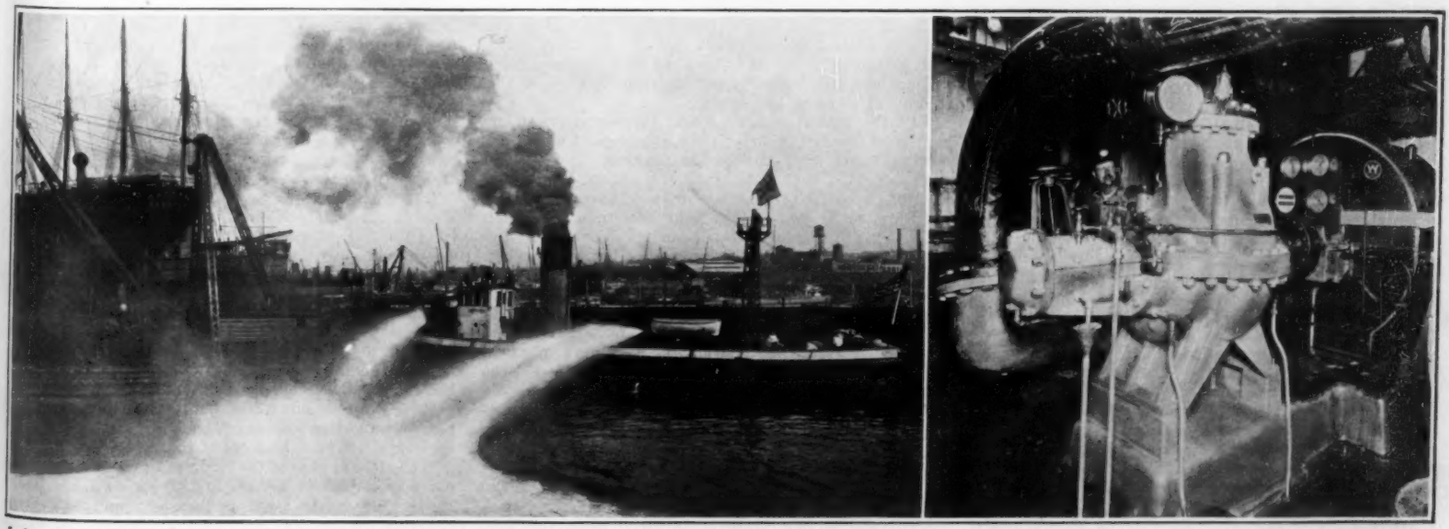
Within the past few months two of the fireboats, the "Thomas Willett" and the "James Duane" have had their pumping equipment changed over to a two-unit installation of Westinghouse horizontal impulse turbines of 600-horsepower rating, directly connected by a flexible coupling to Lea Courtney horizontal-shaft single-stage centrifugal pumps of special high-speed design. The specifications of the new equipment called for a capacity slightly over the old system, and demanded guarantees to cover the following discharges of salt water per unit, the quantity of water varying with different pressures as follows:

Three thousand six hundred gallons of salt water per minute at a pressure of 175 pounds per square inch and 4500 gallons at 150 pounds pressure when operating at a speed of 2000 revolutions per minute, and when the two units operate jointly, they must develop 300 pounds pressure at the pumps and discharge 4600 gallons of salt water per minute.

The two steam turbines were to be supplied with a total of 25,000 pounds of saturated steam per hour at a 200-pound pressure, exhausting into a condenser with a vacuum of 26 inches, under which conditions the turbines were not to exceed 550 horsepower, leaving the 10 per cent additional rating for an overload. The shop tests passed these specified requirements.

In the official tests of the installations the "Willett" discharged 9800 gallons of salt water per minute at a pressure of 150 pounds with two pumps in series, 7900 gallons at 175 pounds pressure with two pumps in series, and 4850 gallons at 300 pounds pressure on joint operation of the two units, while the tests with the "James Duane" were equally satisfactory. The gratifying results by no means indicate the total capacities of the units, as the low steam pressure and the low vacuum of the two dock tests were below normal operating conditions. The acid test, when the boilers are fired to capacity and the engineers are experiencing the thrill of fire-fighting, will prove the full value of the turbine-driven pumps in the serious business of fighting harbor fires.

The city officials are said to be satisfied with the installation and one prominent chief is quoted as saying that "no reciprocating pumps are likely to be installed in fireboats." This same chief is also of the opinion that with the great developments of New York Harbor and piers it will soon be necessary for the Marine Division to increase its fleet, perhaps even double it, within the next few years. Meanwhile, the increased capacity of the present units, brought about through the use of turbines and centrifugal pumps, is a step in the right direction.



Left: Powerful streams of water from a New York fireboat equipped with steam-turbine-driven centrifugal pumps in place of the usual reciprocating steam engine pumps. *Right:* One of the steam-turbine-driven centrifugal pumps aboard a fireboat

A Square Deal for the Psychics

Criticisms from Various Sources of the James Black Articles, with the Editorial Verdict

By J. Malcolm Bird, Associate Editor

OUR ISSUES of August and September carried articles by Mr. James Black, of Montreal, under title "Do Tables Tip?" and "Ectoplasm and Ectoplasm Fakers." With vitriolic pen Mr. Black sets forth his inability to accept the psychic phenomena produced to date, or even to grant the good faith of the producers. That such a challenge would go unanswered was not to be expected.

Among those adversely mentioned by Mr. Black is the well-known medium Ada Besinnet, of Toledo. Miss Besinnet, and her friends in considerable number, have written in protest; and this matter takes rank as the main issue between Mr. Black and his critics. That Miss Besinnet's friends attend her seances and come away convinced that there is no fraud is interesting; but without prejudice to them or to the medium we regard it as immaterial. Miss Besinnet performs only in absolute darkness; and when laymen attend such a seance, where no attempt at control or at test conditions is made, their testimony as to the presence or the absence of fraud is obviously, in the legal sense, incompetent.

Their testimony that they have known Miss Besinnet for considerable periods and regard her as incapable of fraud, on the other hand, is competent. Mr. Black is not bound by their opinions, and may cheerfully proceed to ignore them and convict her of fraud, if he can. But character testimony establishes a presumption in the medium's favor which may be overcome only by an array of facts; and this array must be stronger in the presence of favorable character testimony than in its absence.

In presenting his case against Miss Besinnet, Mr. Black is admittedly a commentator rather than a direct investigator. He has not seen her perform; his source of information is the report of Mr. J. H. McKenzie, who *has* seen her. One of Miss Besinnet's adherents would throw him out of court on this ground, with the bald statement "Why, he was not there!" This we think is extreme. Mr. Black, or any other person capable of reading English, enjoys the privilege of reading and interpreting McKenzie's report; of agreeing or disagreeing with McKenzie's procedure and with his conclusions; and, if he considers that McKenzie has done or said anything wrong, of proclaiming this to the world with the reasons for his belief. If this be not permissible, what is the McKenzie report for? or what protection exists against misrepresentation therein?

Miss Besinnet, and her chief supporter, Mr. W. W. Roche of the *Toledo News-Bee*, concede Mr. Black the privilege of comment and criticism upon the McKenzie report. But they object strongly to the way he has exercised this privilege, contending that he has misquoted and misrepresented, and made it appear that the report was adverse to the medium, when in fact it endorsed her.

Miss Besinnet has loaned us a copy of the McKenzie report. Its author is Principal of the British College of Psychic Science. This body is not be to confused with the British Society for Psychical Research; its object, according to the prospectus in its Quarterly Transactions, is "not to inquire whether life continues beyond death but to demonstrate that it does." The report appears in Vol. I, No. 1, of these transactions. We find it altogether an extraordinary document, and one which we would reprint in full if we had the space for its 25,000 words. Since we have not, we quote such passages as are germane to what Mr. Black has said and what we shall say. We must ask credit for the statement that these quotations, fragmentary as they are, do not garble or distort; that they give the report a square deal and convey, so far as is possible in this space, its complete sense. We attach paragraph numbers for convenience of reference.

"Miss Besinnet arrived in England on May 17, 1921, and departed November 26, in fulfilment of a six months' engagement at the College. . . . During this time 100 seances were conducted, 14 of these being held under strictly test conditions. . . . (1)

"Hyslop . . . tested Miss B's mediumship during 1909-10. . . . Many of the facts, both mental and physical, . . . which he proved have been verified at the College, but I do not agree with all his deductions from these facts, and in some points consider these to be quite erroneous. The Professor has referred to the mediumship of Miss B as 'a case of hysteria.' The conclusions I have arrived at . . . go to show that those actions of the medium which Hyslop attributed to hysteria may be fully accounted for as due to the action of controlling spirits. . . . (2)

". . . considering that she sat with the sitters immediately on her right and left, one would have supposed it a simple and easy matter to arrive at conclusions regarding the genuineness of her psychic manifestations. This I have not found, but must rather state that her mediumship has been the most baffling and difficult to check of any physical manifestations that I have hitherto tested. . . . (3)

". . . it was found imperative that the experiments be conducted in total darkness. [Instances are related where trivial lights, such as the spark caused by the withdrawal of a live electric plug from its socket, prevented or interrupted the trance state.] The same thing occurred when brilliant psychic lights were produced by her own mediumship. . . . (4)

"No. 9 sitter was able during the seance to rest his left arm against the medium's right. This sitter, however, was usually moved away some little distance from the medium, the 'control' using her right hand [*i. e.*, the medium's] to press him back. . . . (5)

"[Of the typical seance,] about three-quarters of an hour were devoted to direct voice, singing and whistling, moving lights, and tambourine playing. . . . The second part, about three-quarters of an hour, was usually devoted to the presentation of faces, these being illuminated by a bright light held in a left hand. . . . The third and last portion was devoted to the production of low, whispering voices in the trumpet, purporting to give communications from deceased relatives and friends, and also to the production of writing upon the letter-pad which lay upon the table. . . . (6)

"Generally speaking, all physical phenomena were produced within the field of the medium's physical body. . . . The same would apply to [the raps,] the voices, the movement of the tambourines, and the lights. While stating this frankly, it must not be misunderstood, for these manifestations frequently took place when it was physically impossible for the medium to perform them. . . . (7)

". . . these faces were probably the result of facial muscular control of the medium's face while in trance, or 'transfigurations' through the use of ectoplasm built upon the face. . . . The evidence . . . proves that while in trance her body was taken out of the chair and brought forward over the table. . . . (8)

". . . the lights which accompanied the faces . . . during the first three months . . . seemed to arise from the point of the little finger of the hand which held the light, but in later seances . . . from the interior of the hand. They would flash to their full strength almost instantaneously, remain burning for one or two seconds, and instantaneously disappear, though on some occasions they extinguished gradually, going . . . to a dull red glow before disappearing. . . . (9)

"There was also distinct evidence on some occasions that the medium's hand and arm, while she was in trance, were used in the manipulation of the tambourine. It was never possible to follow the exact movements of the medium's body during the seances until the last week, when an electrical apparatus was constructed . . . which enabled me to ascertain her movements, whether in or out of the chair . . . (10)

"I made many secret attempts . . . to feel carefully with my right hand exactly where the medium's body was during the manipulation of the tambourine, more especially to find her left hand. Upon every occasion but one, recorded later, the movement of my hand was detected by the 'control' Black Cloud [claiming to be an American Indian], and without remark it was pushed back by a hand, probably that of the medium. . . . (11)

"FOURTEENTH TEST SITTING [the one to which Mr. Black refers in detail]: The medium on this occasion was not searched and wore her own clothes. . . . The first face, . . . which is believed to have been surrounded by white drapery, . . . was accompanied with the usual psychic flashlight, and had a very general similarity in appearance to the medium's face. . . . Upon the appearance of the second face, . . . it was noticed that the head was enveloped in white drapery. . . . Upon the face being illuminated with the psychic light for a second time, No. 1 sitter held the electric torch . . . directed upon the face, and pressed the switch, thus clearly illuminating the face, head and shoulders of the medium, whose body was well up out of the chair and bending over the table. . . . With her right hand resting upon the table she held in her left the psychic light, which was shining upon her face. . . . (12)

"There was unquestionable evidence that the face shown was that of the medium; that the brilliant light illuminating the face was of psychic origin; that the drapery around the head of the medium was an ectoplastic structure. . . . (13)

"THE ROPE-TIED MEDIUM: . . . Black Cloud [who was supposed to do the tying] at the end of this time [about seven minutes] would ask for the red light to be turned on, and invited two of the sitters to . . . see that the tying had been properly done. . . . The red light was then turned out and within a few seconds the tambourine was played; the light was again called for by Black Cloud, only to show the medium still seemingly securely tied in her chair and in deep trance. . . . (14)

". . . a trick tie, as was undoubtedly resorted to. This . . . enabled the medium to slip her left hand from the rope and manipulate the tambourine with it, as was certainly done. . . . There is no doubt that the tying of her legs . . . and her back to . . . the chair, and finally her right hand to the left hand of sitter No. 9, was also done with the use of her left hand, leaving a loose triple link upon the arm of the chair into which she slipped her left hand, . . . twisting her hand and arm . . . to tighten the tie. My suspicions having been aroused, . . . I secretly extended my hand while the tambourine was being played, and after several efforts . . . found that the medium's left hand was out of the rope. . . . (15)

"It is idle to charge the medium in these actions with a tricky secondary personality of her own [as Hyslop did]. Either she was deliberately and consciously cheating, or the work was that of spirit control. There is no need to talk of a mythical, subconscious, secondary personality to account for the manifestation. The

JAMES BLACK, in our September issue, indicates that McKenzie investigated Miss Ada Besinnet's mediumship and pronounced it fraudulent. The fact is, Mr. McKenzie indorsed Miss Besinnet squarely; Mr. Black simply decides that McKenzie was wrong and kindly corrects his error for him. Mr. Black in addition makes misquotations regarding the details of McKenzie's work, and of the investigations into Neilsen, Carriere and Home likewise; and in defense, he merely insists upon the privilege of substituting his own version of McKenzie's facts for McKenzie's version.

Psychic science in its present state is necessarily controversial. Investigators predisposed toward the genuineness of their phenomena find it difficult or impossible to proceed in a manner that shall satisfy those with negative predisposition. Mr. Black now demonstrates the converse of this proposition; that a supposedly fair-minded unbeliever cannot be trusted to give the psychics a square deal. We had hoped, in presenting a series of representative summaries at second and third hand, to exhibit the true status of psychic investigation without running afoul of this human frailty. Since this seems not possible, we are done with second- and third-hand discussion; the announcement made on page 389 indicates the means we are adopting to insure that whatever more we have to say in this field shall be at first hand.—THE EDITOR.

only satisfactory explanation of these controls is to put them down for exactly what they claim to be. . . . It is quite reasonable to suppose that this Red Indian, Black Cloud, had the same weaknesses as are to be frequently found among mankind, *i. e.*, a desire to play upon the credulity of his fellow creatures. . . . (16)

The report closes with a general endorsement of Miss B's mediumship, not amenable to concise quotation, and a word of reassurance to the members of the College who might be disturbed by the very considerable portions of the text which are out of harmony with the conclusions. A letter is attached from Conan Doyle, who congratulates Mr. McKenzie for his uniformly sympathetic attitude toward the cause he was investigating.

Mr. Roche, in his original letter of protest against Mr. Black's version of all this, says: "I am not attempting to argue the character of the phenomena which occur through Miss B. I am protesting against the falsehood of the Black article as it refers to her."

Mr. Black has seen this letter, and in an extensive reply thereto insists upon arguing the character of the phenomena. Thus, McKenzie reports: "She held in her left [hand] the psychic light, which was shining upon her face. . . . There was unquestionable evidence that the light was of psychic origin." Mr. Black says: "In her left hand a small electric torch provided the ectoplasmic light." Taken to task by Mr. Roche for the discrepancy, Mr. Black retorts, in effect, that he doesn't believe in psychic lights, that it could have been a torch, that McKenzie hasn't proved it wasn't a torch, that it must have been a torch, that it's silly to call it anything else and that he is going to call it that.

Save for Mr. Black's admitted and unimportant error in transferring the rope-tying stunt from the seance when it occurred to one when the medium was not tied, this is typical of the sort of thing which he has done and of which Miss Besinnet's supporters complain. The question narrows down to one of just what he was doing on page 215 of our September issue. He was not quoting directly; does this relieve him of obligation to his authority? Is he justified in substituting his own version of what he infers to have taken place for McKenzie's statement of what did take place? Is he within his rights in mixing direct abstract with his own conclusions in contradiction of his authority? It must be admitted that such conclusions are within the historian's province to form; he is continually revising and rejecting his authorities. But he must *always* tell what his authority said; why he accepts this, and rejects that; above all he must indicate with precision what parts of his conclusion are his own, and what drawn from his authority.

Absence of quotation marks offers no escape. Mr. Black names McKenzie as his source. He has no right to depart from McKenzie without giving notice. How are we to tell what part of his story is McKenzie and what part Black? How are we ever to suspect that it is not all McKenzie? Mr. Black may be acquitted of intentional deceit; we believe he has merely allowed his enthusiasm to run away with him. But he has arbitrarily put his own conclusions into McKenzie's mouth; the man who investigated Miss B, and squarely endorsed her, Mr. Black has made to denounce her as a fraud.

We are the more dissatisfied with Mr. Black, in the light of the McKenzie report itself. Here is this document, bristling with weak points which its warmest friends must know need bolstering—need a lot of it, and need it badly. Here is Mr. Black, eager to discredit it. And the best he can do is misquote it!

Let us not be misunderstood. The requirement of darkness is not necessarily proof of fraud or hysteria. We do not accuse the photographer of chicanery because he shuns the light, and insists that what light be present, be red. We know also, if we will but admit it, that a hostile atmosphere *does* make more difficult the exercise of the mental faculties. Why, then, are we so very certain that the medium is a fraud because she must work in darkness, and because she cannot produce the same results, with the same facility, at all times and in all places and under all conditions?

We are willing to go still further in the admission of what many regard as damning procedure on the medium's part. In the volume with the McKenzie report appears an article "General Laws Underlying Trance Communication," by the Rev. C. Drayton Thomas. Mr. Thomas writes in full belief that communication "with our friends who have passed into the next life" is a verified fact. If this assumption were omitted, and the article written to present the conditions which *would probably* govern attempted communication *provided there be* personal survival, it would be one of whose authorship anyone might be proud.

Man makes his ghosts, like his Gods, in his own image—though sometimes he uses some other familiar image, so that we get bears as Gods and cockroaches as reincarnated humans. It takes intelligent sophistication to realize that if we *do* survive, it is doubtless in a form and under conditions inconceivably different from those of our present existence. The spirits whose existence Mr. Thomas takes for granted, and which we must all be willing to "postulate" in the mathematical sense of the term, do nothing as we do. They do not communicate with one another by speech, or even with words. Out of whatever form of expression they may use, only a select few can translate into words; and then only with difficulty and with large hazard of error. They lack direct means of presenting these words or the content thereof to any of our senses.

Mr. Thomas fairly drives one to agree with him that, *if there is* a future life from which communication is attempted, the very things would happen which he pictures. And what then? Is it not altogether logical to suppose that the hypothetical communicating spirit, needing voice or hand or face and having none, will use the medium's? If you object to seeing things done at a seance by the medium's anatomy, I would ask: Assuming these things are to be done, how else in Heaven's name do you expect them to get done? This is science we are supposed to be studying, not black magic. I, for one, would rather believe that the spirit needs, and has some way of controlling, a physical agency, than that it can dispense with such agency in the production of physical effects.

Now these concessions to the psychics are all very well; but we expect something in return. We expect them to admit that these very features of darkness, uncertainty under test, and use of the medium's anatomy *would* characterize a fake seance. We therefore expect them to grant the prime necessity of attempting to discriminate between fraud and bona fide mediumship. Not a professional investigator, I stop short of suggesting how such discrimination might be accomplished; but clearly it must be attempted.

Except for vague hints that the "experienced investigator" knows what he is doing, the McKenzie report conveys no idea of how this discrimination was achieved, and suggests strongly that it was not attempted. When the sitters got too close they were pushed away. The medium's hands executed a trick tie. The attempt to learn what her left hand was doing was vetoed. If Mr. McKenzie wishes to believe that it was the spirits who did all this and not the lady, that is his privilege; but in a serious document intended to silence doubt, it is really up to him to explain how and why he reached that assurance.

Mr. McKenzie is clearly gripped by the will to believe. One really wonders why it was felt necessary to squander all that perfectly good darkness on him; a daylight seance would have been less emotional, perhaps, but from no other viewpoint would it have made any apparent difference to this investigator. He starts and finishes with the avowed intent of "demonstrating" and he is bound to demonstrate. The true scientific attitude, requiring that every possible explanation using old theory in whole or in part be exhausted before we turn to new theory, and scrupulously refraining from all prior bias—this is the last thing in his mind.

Take our quoted paragraph 16. Hysteria is an intrinsic possibility; barring fraud, it affords the one avenue of normal explanation. It is a theory that would require, for its proof or disproof in any given case, the most painstaking investigation of a competent psychologist; and even then, the psychologist would put forward a positive conclusion with diffidence. Not so McKenzie: he waves this explanation away with a casual gesture! And he calmly informs us that he disagrees with Hyslop's conclusions, and lets it go at that! Disagreement with Hyslop in his field is on a par with disagreement with Lindenthal or Steinmetz in theirs; it requires particulars of where, and how, and why, Hyslop is wrong and the correction valid. McKenzie does not even seem to realize that this is in order.

By way of an illuminating sidelight, we remark that Houdini, the conjurer, has a trick in which he is all messed up with handcuffs and straightjackets, and pitched into a steel tank full of water. The tank is then locked, and after a decent interval, Houdini calmly walks in from the next room. Mr. McKenzie is on record with an explanation of this. It is not sleight of hand at all, he tells us; it is much simpler than that. Houdini merely "dematerializes" himself, filters through the walls of the tank and of the room in this condition, and reassembles himself, suspender-buttons and all, on the other side. And the author of this lovely idea presumes to "correct" Hyslop—and without stating his case in detail!

McKenzie's paragraph 2 gives further evidence of his bare-faced determination to ignore all possibilities outside the one for which he is working. Miss B's actions *may be* fully accounted for as due to controlling spirits! So may the phenomena of radio broadcasting; but that is far from proving that the spirits speak through WJZ. May be, wants to be, must be—the chain of reasoning is simplicity itself. He doesn't need any unwelcome hypotheses (see paragraph 16), and none need try to force themselves upon him.

Paragraph 3 would better express the true difficulties of the case if, before "conclusions," the words "rigorous affirmative" were inserted; and if the verb "check" were similarly modified. Conclusions and checks of the sort that satisfy McKenzie seem fairly easily come by.

Paragraph 16, in which McKenzie makes a little excursion into ghost psychology, finds him at odds with his star contributor. The Rev. Mr. Thomas would be the last man, we think, to admit that the probable viewpoint and behavior of a ghost could be deduced from those of a man. But Mr. McKenzie goes right on modeling his ghosts in the human image. His picture of the naughty little spirits is sublime.

McKenzie has put the best face on the matter that he could. Does it follow that Miss B's mediumship must be discredited along with his report thereon? We do not think so. McKenzie has disqualified himself so thoroughly that there can be no confidence in his ability to see and weigh everything that occurs at the seances, no assurance that he has not overlooked something a better investigator might regard as significant. If we feel that the report is so inept that we could in no event indorse the medium from it, we should feel the

(*Continued on page 443*)

Lighting the Mississippi

The Illumination that Makes the Father of Waters as Safe by Night as by Day

By George H. Dacy

NIGHT navigation on the Mississippi River and her leading tributaries is now as safe as daytime voyaging as a result of the illuminating beams of more than 2700 shore, float and buoy lamps which are used to light the inland rivers from Minneapolis to New Orleans. Without these beacon lights navigation at night on the Mississippi would be dangerous because of her crooked, curving and tortuous course. The "ol' Mississip' " is so crooked that on some stretches south of St. Louis carefully standardized compasses show that the river steamers pass through all directions of the compass twice in traveling distances of 30 to 40 miles. The bird line paths between two points on these exceptionally crooked courses are less than half as great as the water distances. The river turns, twists and weaves and winds about as though she were doing a constant loop-the-loop.

The U. S. Bureau of Lighthouses has charge of keeping the inland rivers well illuminated for night traffic. The areas bordering the Mississippi River are divided into three lighthouse districts. District number 13 covers the upper Mississippi from St. Paul to St. Louis and includes such tributaries as the Missouri, Illinois, Gasconade, Osage, Minnesota and St. Croix rivers. District number 14 includes the Ohio River from Pittsburgh to Cairo and also such tributaries as the Tennessee and Kanawha Rivers. District 15 covers the lower Mississippi from St. Louis to New Orleans and includes such tributaries as the Red River.

The Mississippi changes her course so frequently by gouging out and carrying away huge areas of the river banks, first on the east and then on the west side of the channel, that it is a difficult matter to keep the safety lights in the most prominent positions. The river boats and steamers cooperate with Uncle Sam by notifying the headquarters of the different districts whenever they locate lights or day signals that have been washed away or otherwise put out of commission. The day signals are usually crossarms painted white and placed at such an angle that they reflect sunlight best and hence are easily visible from midchannel. They are perforated with holes so that the winds can blow through them without tearing them from their moorings. They usually are placed in conspicuous spots along the high river banks and are attached to the same supports which carry the signal lamps.

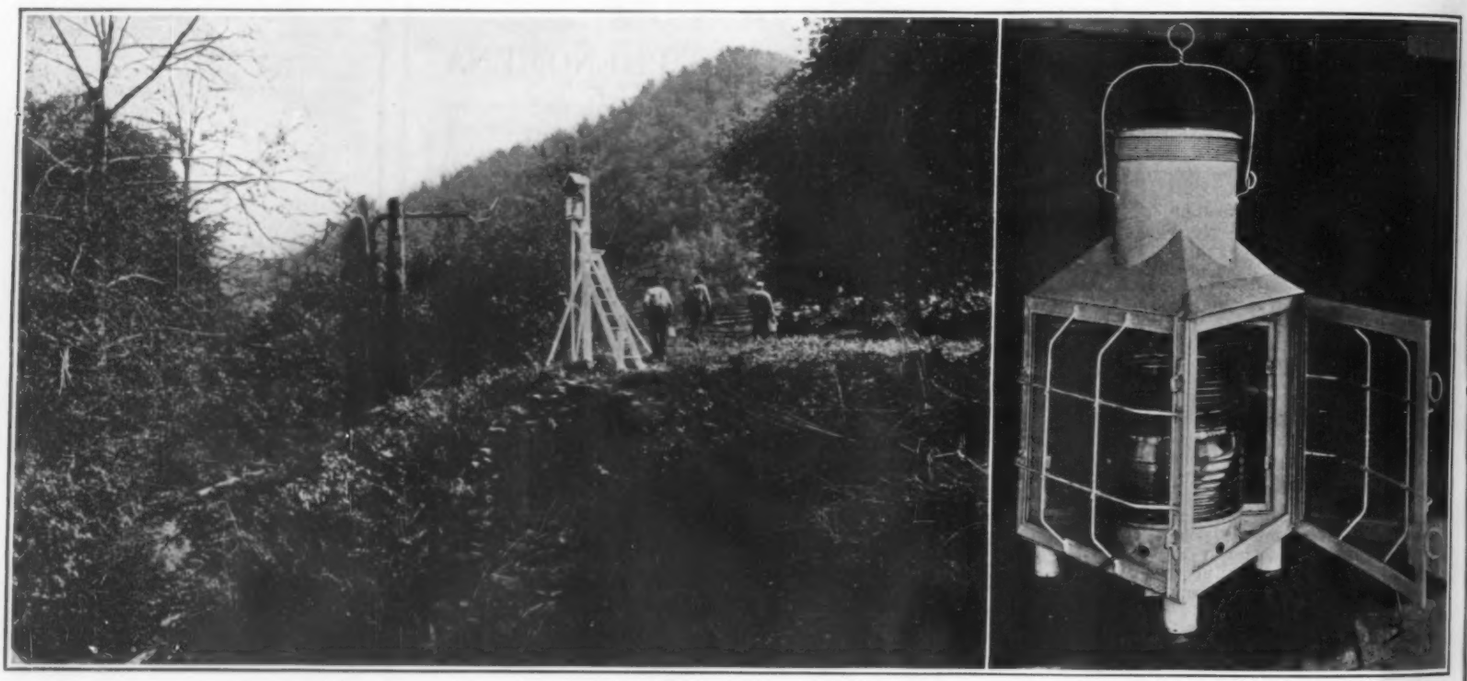
The signal lamps used on the interior rivers are very simple and easy to take care of. In some cases they consist of ordinary 14-inch hand lanterns inclosed in square or triangular tin cases with plain, glazed sides. Other types feature the use of one-inch flat wicks and pressed glass lens about 8 inches in diameter with glass on either two or three sides as the location requires. In each case a wire screen is fitted to the top of the lantern to prevent the entrance of insects. All the lamps burn kerosene and most of them display only white lights, although some are fitted with red globes or shades. The channels of our inland rivers generally follow the concave banks, with crossings where the concavity shifts from one side of the river to the other. The lights are located so as to show the general shapes of the bends and positions of the crossings. The lights are usually placed on the river banks and the crossings, identified by two range lights, one ahead and the other astern. Where the crossing is unusually crooked a series of range lights sometimes have to be used, and during low water some of the lights are placed on sand bars or on small floats or rafts. The post lamps are as permanent in position as the caving banks of the river will permit. In times of washouts, temporary expedients have to be used, the simplest of which consists in attaching the lamps to trees close to the river banks.

Buoys are used where the channel is very narrow or crooked or where the ends of wing dams are to be marked. The river conditions are such that floats of this character are most satisfactory if they have but slight reserve buoyancy, in order that drift and river debris will pass over these buoys, submerging but not displacing them. One efficient type of buoy consists of a built-up spar with a central barrel-shaped section fitted with galvanized sheet-iron cones or hoods at each end. A slide for a hand lantern is provided at the upper end, while the buoy is moored by a light wire cable fastened to the lower end with an iron weight as a sinker. Another type is composed of two galvanized sheet-iron cones placed base to base. The upper cone is a right cone while the lower one is oblique, in order that the buoy may not spin in the current and untwist the light wire anchor cable.

The lights are tended by farmers or laborers living in the vicinity. They are paid approximately $7 apiece for tending each accessible beacon and as high as $10 for remote lamps. They light the beacons every night at sunset and extinguish them at sunrise. They trim the wicks, keep the lamps filled with oil and the globes clean. The government furnishes all the supplies for the maintenance and repair of the river lamps. Many of the lights are on uninhabited islands and along remote stretches of the rivers where settlement is scant. The light tenders have to use boats to reach these remote beacons.

Three government boats of the stern-wheel type, each 150 feet long and 30 feet wide and of extremely light draft, patrol the Mississippi and her tributaries, carrying supplies to the light tenders and keeping tab on the changes in the channels and the positions of the signal lamps, floats, buoys and day signals. One of these boats covers a special beat in each of the river lighthouse districts so that the entire Mississippi is satisfactorily policed. From an illumination and signal standpoint, the river lights are very satisfactory. On a clear night the individual lamps can be seen for distances of from two to five miles, dependent on the topography of the country and the course of the river.

An official light list is issued annually by Uncle Sam and distributed free of charge among all the river men, pilots and guides. It provides complete information which would enable any stranger to find his way down the Mississippi and know exactly where he was at any particular time. It gives the number, location, position, color and distance from St. Paul of each light. It tells whether the lamp or signal will be on the right or left bank of the river. It gives the names of all the towns and villages and their distances from St. Paul.



The manner of mounting the Mississippi lanterns, and the details of the lamps themselves

Proposed Improvements in Manila

PLANS are under consideration for various improvements in the city of Manila, which may later be of interest to American contractors and exporters of machinery and iron and steel products, George E. Logan, manager of the Manila office of the Department of Commerce reports. Among them is the plan for using the Angat River as a source of water supply for the city. If the proposed plans are approved, a hydroelectric plant will be constructed, the sewer system will be extended, and the present Montalban Reservoir will be used for irrigation. It is thought that the total cost will be from $6,000,000 to $8,000,000, and considerable amounts of cast-iron pipe, steel of various kinds, cement, lumber, electrical apparatus, copper, and aluminum will be used, as well as machinery of various kinds. The work will probably be advertised in the technical papers and sufficient time will be given to enable manufacturers and contractors from the United States to investigate conditions and prepare their bids.

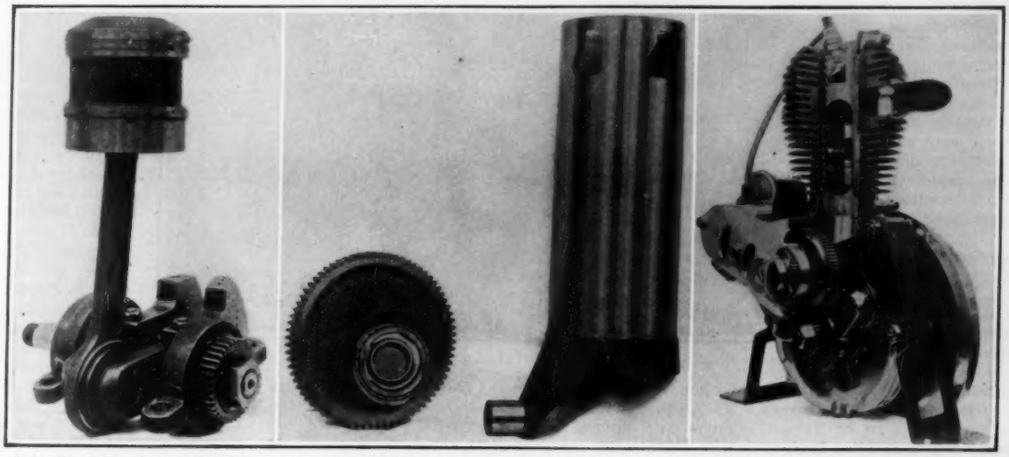
Sleeve-Valve Engines for Motorcycles

AMERICAN motorcycle-engine design, characterized by staunch adherence to the poppet-valve twin-vee of some seven horsepower, has produced a machine well suited to high speed and hard work over long stretches of rough roads and hilly country. Such machines, however, are little used in Britain save with the side-car. Accordingly in British design the trend is toward reducing the size and weight of the power unit; and the single cylinder and the flat twin are far more in evidence than the vee twin.

In this connection the success of the sleeve valve in well known cars has led one of the patentees of this device to introduce the system into a single-cylinder, air-cooled engine for motorcycles. There is something of a departure in the combination of air cooling and sleeve valve; but the showing of the new engine in its road tests seems to justify the experiment. It is not necessary for us to go here into the merits of the case, poppet vs. sleeve valve, to indicate that the advantages of the system outlined may be very material.

The engine in question has a cylinder 70 millimeters (not quite 2½ inches) in diameter, and a stroke of 90 millimeters. With 349 cubic centimeters displacement, it is rated in England as of three horsepower, though under test it has developed seven horsepower at 400 revolutions. The general layout of the engine will be noted in the third view, in which it will be observed that there is an outside flywheel. This is becoming a common British practice with single-cylinder engines.

Lubrication is on the ordinary splash system, the base of the crank-case being ribbed to assist in the cooling of the oil. This lower part of the crank case is separate from the upper part; the latter is of cast iron and really part of the cylinder casting. The removal of the bottom half enables the whole internal assembly to be taken out bodily.



Left: The internal assembly of the piston, etc., which is withdrawn from the bottom instead of by opening the crankcase longitudinally. *Center:* Details of the sleeve valve, which rotates so as to bring the proper ports opposite the annular belt around the cylinder at the necessary times. *Right:* General view of the engine, showing external fly-wheel and detachable cylinder-head

The air-cooled, rotary sleeve-valve engine of one cylinder that appears on a British motorcycle

Cleaning Wheat at the Threshing Machine

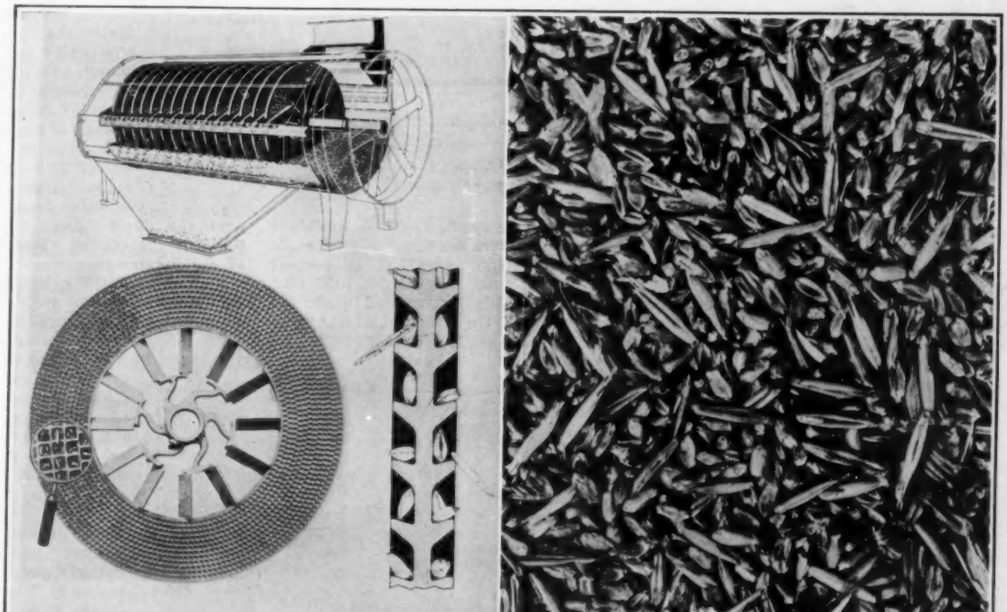
THE growing of wheat is one of the biggest agricultural enterprises in the world, the United States alone producing approximately 800,000,000 bushels annually. One-third or in excess of 250,000,000 bushels of the total production is yielded from grain, sown in the spring months, when weeds take growth and infest the ripe wheat at harvest time. Seeds from these extraneous plants—wild oats, wild buckwheat, tame oats, mustard, barley, etc., contaminate the flour-yielding product and unless discarded before offered for sale on the market "dockage" is assessed. Thus, the commercial value of the grain is materially lessened.

The material discarded as "dockage" of the 1921 crop of spring wheat exceeded 10,000,000 bushels of sixty pounds each. Feed value is attached to a certain percentage of this collection of weed seeds and faulty grain, but the cost of removal at the elevators and flour mills offsets its value. Mechanical contrivances for discarding the foreign growth when the wheat is being thrashed have heretofore proven only partially successful, due to the difficulty of removing wild oats. R. H. Black of the Office of Grain Standardization of the United States Department of Agriculture, however, seems to have solved the problem by the recent introduction of a newly designed machine. The apparatus weighs only 670 pounds and operates on the basic principle of disks provided with tiny pockets, the movement being vertically through the grain. The elevator and mill machines bearing similarity to this design weigh from one and one-half to four tons.

The disks of this cleaner are constructed of aluminum. Undercut pockets are found on both sides of the disks, and when the latter are installed they are spaced two and three-fourth inches apart on a shaft which rotates at a rate of sixty revolutions a minute. The center of each disk contains fan blades for moving the grain toward the discharge end of the cleaner. The pockets, being slightly undercut, select material of a specified length and discard products of a greater length. As the disks move vertically, the material picked up by the pockets is conveyed up and over the top of the rotating shaft. Here it is discharged into troughs. Three sizes of pockets are employed for making varying separations, one size of pocket only being used in any one disk. The grain subjected to cleaning is fed into the machine near one end and the fine weed seeds and dirt are selected from the mixture by the first disk containing the smaller-sized pockets. As the grain progresses through the apparatus the disks provided with larger-sized pockets appropriate the wheat kernels and refuse acceptance of the wild oats, barley and other extraneous growth longer than wheat. The refuse is discharged through the opposite end of the machine. When the mechanical contrivance is functioning, the fine seeds are dumped into sacks at one side of the separator; the cleaned wheat finds an outlet directly into wagons and tanks; and the wild oats and coarser growth which is discharged at the opposite side of the thrasher, may be either sacked or dumped immediately into a second wagon.

Experimental demonstrations of the disk cleaner in removing weed seeds from 15,000 bushels of grain, according to Government claims, established conclusively that foreign material can be discarded from wheat at the time of thrashing. No dockage was assessed in the market places when the grain was thus treated. During the 1921 wheat-thrashing season, when the invention was first given practical application, grain containing as high as thirty-six per cent of dockage was refined to the extent that no discount for foreign material or dockage was made when the product was marketed. The outfit was driven from a fan shaft and slightly in excess of one horsepower was required to insure its operation. Grain possessing in excess of twenty per cent foreign material was renovated by making slight adjustments of the disk cleaner, the dockage also being reduced to less than one per cent. Fortunately, screenings discarded in the cleaning operations are remarkably free of wheat—a testimonial to the efficiency of the machine."

Foul wheat as it comes from the thrashing machine is probably chiefly responsible for the abundance of wild oats and other foreign growth propagated from year to year in grain culture. Analysis of the wheat being sown in Minnesota and North and South Dakota in the spring of 1921 showed few samples completely free of weed seeds. The quantity present averaged two per cent, with one sample containing as high as eighteen per cent by weight. Measured in numbers of weed seeds sown to the acre among wheat the range is from 2000 to 489,000. Wild oats, wild buckwheat, vetch and kinghead are the plants most frequently infesting grain. Obviously, this extraneous growth must be removed before the wheat is converted into flour. The disk cleaner is calculated to result in the saving of millions of dollars to the wheat growers in the Pacific northwest by the removal of weed seeds at the time of thrashing. The present practice of discarding the foreign material at flour mills involves an economic waste.



Left: Sectional parts of new disk grain-cleaning machine; top shows arrangement of disks in the frame, bottom a cross-section of the disk illustrating how wild oats are separated from wheat, and a side view of one disk. *Right:* Sample of wheat as delivered from thrashing machine, containing heavy admixture of wild oats and other dockage

What the wheat-cleaner has to do and how it does it

Flood Control at Kansas City

How a River Is Being Diverted and Carried Through a Hill

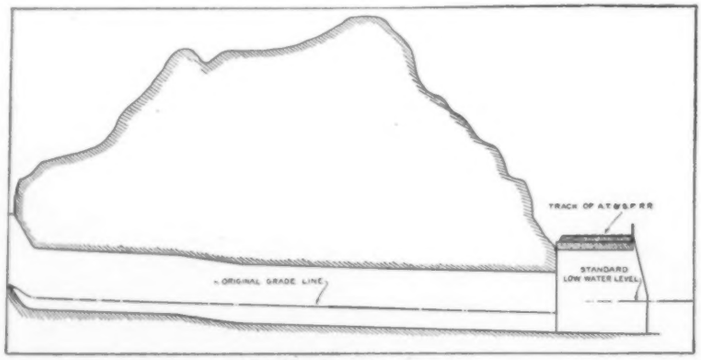
THE settlement of the great watershed of the Missouri-Mississippi River is one of the great romances of history. In an incredibly short space of time this enormous region has been peopled with a vast population and mighty cities have arisen to form centers of material and intellectual civilization. In reclaiming the country from Nature, the people have been busy with the problems that pressed for immediate solution. Consequently, in numerous cases provisions against the intermittent activity of torrential streams have been largely ignored.

But the energy which has been devoted largely to the solution of big elemental problems of settlement is now being directed, here and there, to the control of such streams. In the Miami district in Ohio great works are even now being carried out whose purpose is flood control.

The tunnel portal at the land end

Kansas City has its torrential stream in Turkey Creek. This insignificant little river has a watershed of some 25 square miles, mostly located in Kansas. In 1903 a great flood occurred which resulted in damage in and about Kansas City amounting to about $22,000,000. Later floods have occurred in 1905, 1908 and 1914. This last occasion was somewhat notable. It is not known just what the rainfall was in the hill region of the watershed, but in Kansas City 7.02 inches fell in the course of eleven hours. The natural bed of the creek, especially in the low district in the city, was unable to carry the flood. Part of the valley was inundated to the depth of ten feet. The flood spread south of the point of junction in the Kansas River, and the lake thus formed became deep enough to overtop the levee along this river.

In consequence of such lessons the authorities are now constructing works which, when completed, will shorten the Creek and divert the waters to a new point of entrance into the Kansas River. Provisions are being made to carry a stream having a flow of 20,000 cubic feet per second. An interesting feature of the new works is Turkey Creek Tunnel through the bluff which separates the valley of the Creek from the channel of the river. The cross-section and grading of this tunnel must naturally be such as to carry the aforementioned 20,000 second-feet of water.



Profile along the tunnel

In an accompanying drawing the profile of the tunnel is shown. Likewise the drawing shows the profile of the surface of the bluff along a vertical plane passing through the tunnel. In examining such profiles the reader should be on his guard against an exaggerated conception of the steepness of grades. Because the length of the profile would generally be out of all proportion to its height, if one and the same scale were used for vertical and horizontal dimensions, it is customary to employ a comparatively small scale for the horizontal distances. In the present case any given horizontal measurement represents five times what an equal vertical measurement represents. In short, the drawing is as if it had been compressed between ends to one-fifth the original length.

The tunnel is part of the discharge section of the new route for Turkey Creek. A considerable length of the old waterway north is thus cut off from the rain watershed. However, this portion has its local drainage area just as before and requires a means of disposal. This is to be secured largely through sewer construction that will form part of the general systems belonging to Kansas City, Missouri. In fact, the whole flood-control works will belong in part to Missouri and in part to Kansas.

Turkey Creek Tunnel will be one of the biggest of all tunnel-conduits. Its cross-section is 28 x 28 feet, and the prism of the tunnel lies in bed-rock. As the profile shows, the roof of the tunnel will have a covering running up to about 105 feet. The exact location of the site of the tunnel is probably due to the fact that here it is possible to run the line through limestone bed-rock. Two shafts were put down on opposite sides of the bluff at points which are now near the tunnel portals. On the side away from the Kansas River the shaft disclosed limestone at once; but as the shaft went on down, a gray shale was met and then limestone again. Going further down, they found black and gray shales and then struck limestone again. This is supposed to be the bed-rock of that location. On the side of the bluff next the Kansas River the shaft found bed-rock at a suitable depth.

Collapsible steel forms used in lining the tunnel

From a point perhaps a mile upstream from the location of this tunnel, the old channel of Turkey Creek has been straightened, enlarged and diked. A good deal of this work is of no extraordinary interest, but as the approach, going downstream, is made to the tunnel, the interesting character of the job increases. The levee is enlarged and strengthened to form a dam, whose duty it is to turn the water toward the tunnel. Once through the tunnel, the water will be near its discharge point. To complete the discharge it will pass through a kind of "Subway" conduit running underneath the tracks of the A. T. & S. F. Ry., which here parallel the river.

The tunnel, which is of the horseshoe type, is lined with concrete. In general, the tunnel is driven through limestone; but where shale was encountered in the roof the arch of concrete was thickened.

In fact, changes in the levels originally planned were made with the purpose of keeping the tunnel entirely within the limestone. As the excavation proceeded, the upper rock was found to be unsatisfactory, and 760 feet at the land end of the tunnel has required timbering. In order to get down entirely into the limestone the tunnel grade was lowered about three feet. This change is shown on our profile. Naturally, this has the effect of giving an additional yard of rock overhead, provided the top of the ledge does not itself drop. At the river end of the tunnel the roof has been excavated about three feet low, the expectation being to remove this yard of rock just before putting in the concrete. Now, however, with the lowering of the grade it was possible to leave it in place. For the support of the roof during excavation, 20-foot stretches of concrete lining were put in at about 100-foot intervals.

It is interesting to note that the transfer of the rock spoil to dump cars was effected by a near relative of the steam shovel. In order to avoid the discharge of exhaust steam into the tunnel, the shovel was operated by compressed air instead of steam. It is coming to be more and more the practice to use these big shovels in underground excavations. The exhaust from a compressed-air apparatus provides fresh air, as it is usual to compress the air in a more or less open place and pipe it to the point of use. The shovel employed here was of the 40-ton size.

The bulk of the concreting done in the sides and roof was carried out with collapsible steel forms. The group of 20-foot stretches was, however, concreted with the aid of the ordinary wooden form. Usually the invert of a horseshoe excavation is no considerable problem in respect to the concreting.

The location of the concrete mixing plant near the south portal was on the hill over the tunnel. Thus the mixer was set up back a little way from the portal opening, and off to one side. The hill went on up to a considerable elevation. Deliveries were made by gravity to the mixer as they were required. Then the concrete, mixed and ready for use, was chuted down over the "eave" of the portal and then directed inward to a pneumatic conveyor, by which it was taken through a pipe line to the points desired.

This method of transmitting concrete by compressed air is adapted to the rapid, convenient placing of concrete in places that are rather difficult of access by ordinary methods. On the other hand, there would seem to be difficulties in the way of its general application. One of the desirable things that is associated with pneumatic transmission is the fact that it is usually no trouble to provide for a kind of tamping operation as the concrete goes into place. The system seems especially adapted to the overhead lining of tunnels and the like.

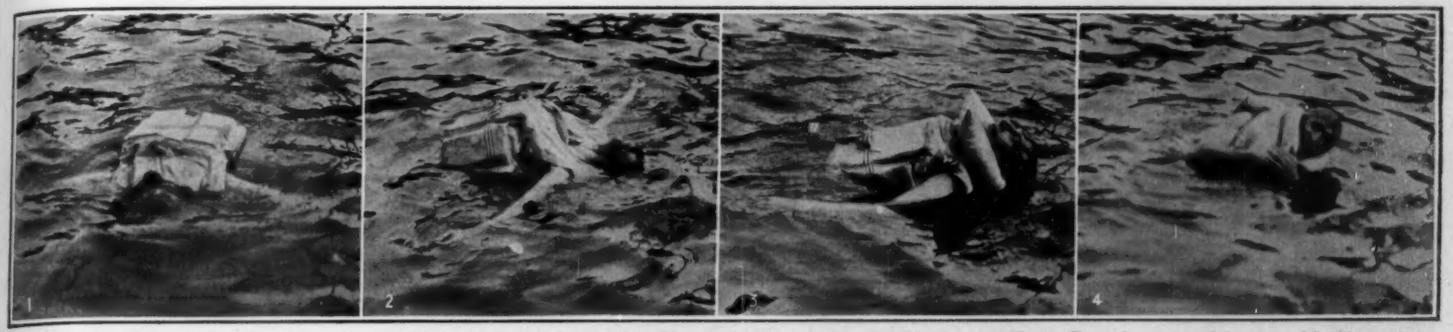


Fig. 1: The position normally assumed by an inert, unconscious body when immersed face downward in the jacket-type cork life preserver. Fig. 2: Even when immersed face upward in this preserver, the mouth is so near the water that drowning is certain and rapid, while the preserver will not turn the body from face downward to face upward. Fig. 3: Position normally taken by inert, unconscious body when immersed face upward in the new life preserver. Fig. 4: Position of rest which a conscious person may assume, in the new preserver, while awaiting rescue or when tired from swimming

The deadly parallel between the old and the new life-preservers

Life-Belts and Near-Life-Belts—A Study of Government Regulation and an Invention

WE are not so far removed from the horror of the wreck of the "Titanic" as to forget its tragic features; and one of the most pitiful of these was the fact that, within a few hours after the ship went down, the rescuing vessels found hundreds of dead bodies still supported at the surface by life-belts. In this case, of course, the low temperature of the water in the neighborhood of the iceberg was the cause of many deaths, but in subsequent accidents, which have happened in mild weather and in seas of a favorable temperature, the same failure of the life-belts to save life has been one of the harrowing features of the catastrophe.

A successful life-belt must do two things; not only must it support the whole body of a passenger at the surface, but it must provide sufficient additional support for his head to make it impossible for the mouth and nose to be immersed in the water. A life-belt that makes no special provision for supporting the head will prove to be worse than useless, for it cannot be denied that the principal duty of a life-belt is to keep the mouth and nose sufficiently clear of the water to permit of free breathing.

When a person collapses, whether on sea or land, there is an entire relaxation of the muscles, and the body becomes completely limp. Probably the majority of people that are thrown into the water, or have to jump into the water in a deep-sea disaster, have sufficient nerve and physical resistance to assist the action of the life-belt by treading water, and, above all, by keeping the head well up clear of the water. There is always a considerable number of old people and women of hysterical tendencies, however, who collapse the moment they find themselves in the water, or soon thereafter, and immediately the head falls forward or backward, the mouth is opened, and drowning occurs in short order.

It was to meet these conditions, and secure a life-belt that would be as efficient in saving the weak as the strong, that the rules and regulations of the Steamboat Inspection Service, as pertaining to life-belts, formerly contained a clause stating that life-preservers shall be "so constructed as to place the main buoyant body of the device underneath the shoulders and around the body in a manner to hold the person wearing it in a backward, reclining, position when in an inert or unconscious condition." Furthermore, they made such changes in the specifications for life-preservers as to include a large buoyant collar attached to the upper part of the life-belt, so as to support the head of an unconscious person; and they also required that the majority of the buoyant material should be at the forward part of a person's body, so that the wearer would be kept in a slightly backward, inclined, position. It was further specified that the collar must be of a soft material such as kapok, and that the jacket be reversible; that is to say, that either face of the jacket could be worn next to the body without impairing its usefulness.

In place of the old and unsatisfactory method of fastening the belt around the body, the new regulations demanded that the upper part of the life-preserver should be made vest-like, and the buoyant material securely fastened in, or incorporated with this vest. Our full-length picture, No. 5, shows a demonstrator wearing a kapok belt without any collar, as built to meet the latest specifications. Another illustration, No. 3, represents a cork-filled belt, built according to the earlier specifications, with the vest-like backing and with the collar attached above it. In this case the demonstrator is completely relaxed and is floating upon his back with his mouth clear of the water. The original rules and regulations, requiring a collar, were given out to the public in June, 1921.

Now, it so happened that these specifications were exactly met by patents that had already been issued to a certain Anna Dean Bailey. However, makers of life-preservers began to make preservers, with the collar, so as to meet the Board of Inspectors' requirements. In so doing they infringed the Bailey patents, and notice of infringement was served by the owner of the patents. Subsequently, not long after this, the Steamboat Inspection Service made changes in the rules and regulations and eliminated the collar, which was the most distinguishing feature of the Bailey patents, and notification of the change was given in a circular letter sent out by the Steamboat Inspection Service on September 7, 1921. With the elimination of the collar the manufacturers were free to go ahead and manufacture as many life-belts as they pleased without being subjected as heretofore to suit for infringement.

Now, the Steamboat Inspection Service was free to make such changes as it saw fit in the life-belt requirements subject, however, to the restriction that nothing should be incorporated or left out of their specifications that would fail to give the largest measure of security possible to the seagoing public. Tried by this test the Board, or rather the Executive Committee of the Board, has failed in the performance of its duty. Proof of this is shown in our illustrations, Nos. 1 and 2, as compared with illustration No. 3. In the last named, as we have shown, the mouth of the unconscious body is sustained by the collar well above the water, whereas in No. 1 the head has fallen forward and is almost completely immersed, and in No. 2, where the person is on his back, the mouth is so close to the water that drowning is only a matter of a brief time, particularly in rough water.

So here we see an efficient life-belt, built to the Government specifications of May 9, 1921, contrasted with the failure of life-belts built after the Government, in its supplementary circular of September 7, had removed the excellent feature which had formed the subject of patent litigation. Another regulation of the Steamboat Inspectors is that life-belts shall carry the greater part of their buoyant supporting material at the front of the body, so that the tendency will be for a person to float on his back, in a slightly backward, reclining position. To meet this regulation in the highest possible degree the engineers who have been developing the Bailey patents produced the life-belt shown in Figure No. 6, in which, except for a pad beyond the shoulders, almost the whole of the kapok with which the life-preserver is filled is held securely in front of the body. To the top of it also is secured a kapok-filled collar. Adjoining this picture is shown picture No. 5, a collarless cork life-belt, built to meet the latest requirements of the Steamboat Inspectors. So large is the percentage of buoyant material in the front of a person's body (picture No. 6) that it is impossible to float face down, and it takes only a few seconds to roll a person automatically over on his back. Our illustration, No. 4, shows a position of ease and rest which can be assumed by a person wearing the suit shown in No. 6, while awaiting rescue, with the head and mouth well above water.

It is difficult to understand upon what *practical* grounds the Executive Committee, which has this matter in hand, has seen fit to eliminate the collar, after it had been recommended by the committee and after it had been proved to be an indispensable part of a life-belt. The traveling public is entitled to learn from the Board what are the good and sufficient reasons for the change.

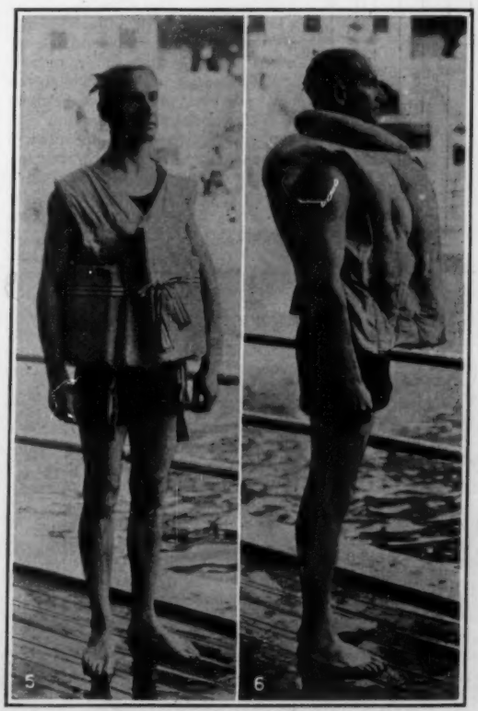


Fig. 5: The jacket-type of life-belt approved by the U. S. Inspection for steam vessels. Fig. 6: Side view of the new and improved kapok preserver with collar

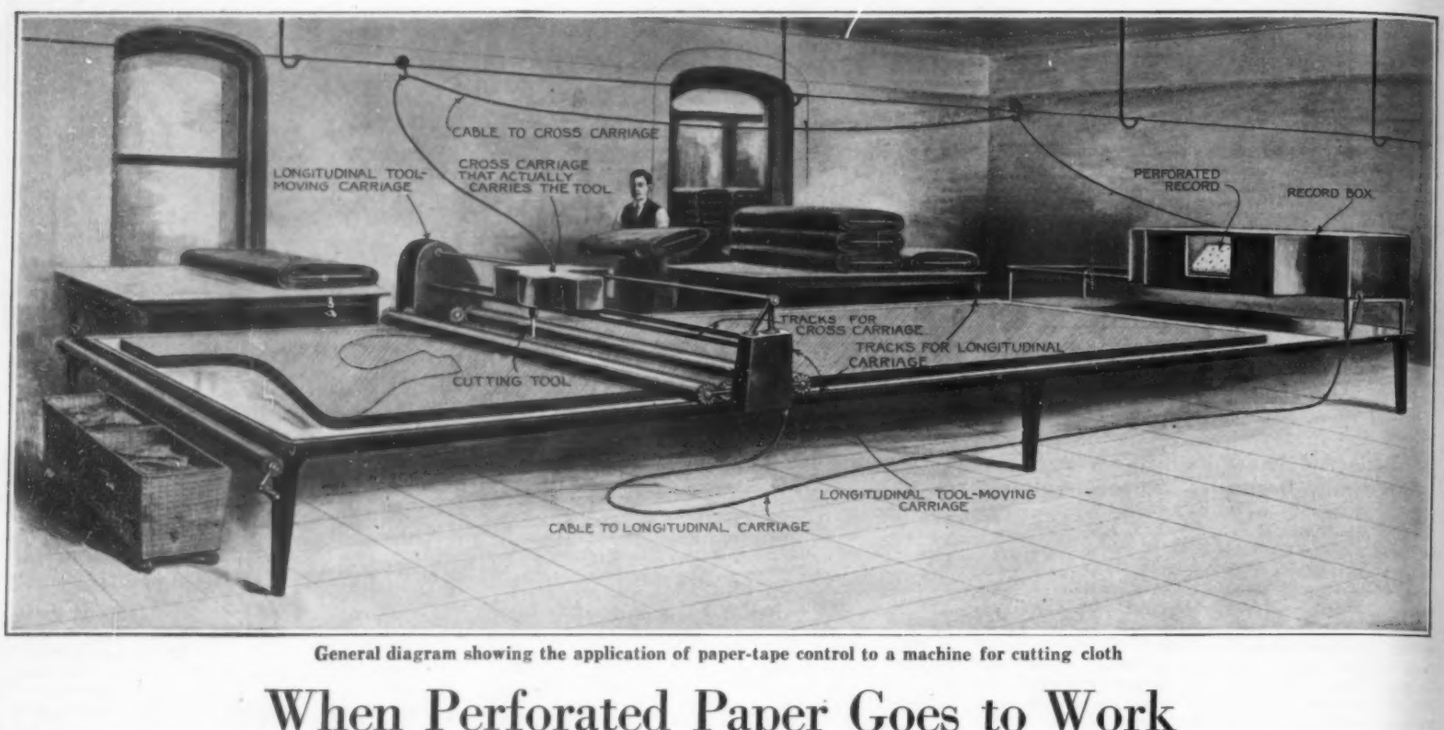
A comparison showing the structural divergence of the newly developed life-belt

A Police Baton Furnished with a Flashlight

A CLEVER idea is that of a Belgian printer, M. Jean Deraume, of Brussels, to whom it occurred that if a policeman's club could be provided with a serviceable flashlight, without injuring its effectiveness in other respects, it might serve a double purpose by being used to signal a fellow patrolman at night or in foggy weather, by means of a simple optical code.

To effect this end an electric lamp is inserted in the end of the baton. The latter consists of a hollow handle within which is a cylinder containing a dry battery. This cylinder is provided with a screw thread at one end, so that the handle can easily be screwed on to the body of the baton by means of a ring, which is also threaded. This arrangement is for the purpose of convenience in replacing the battery whenever necessary.

The dome is screwed to the reflector so as to permit of the replacing of the lamp when required. During the daytime this baton serves the ordinary purposes of a policeman's club or "nightstick." At nighttime, or when the weather is foggy, the switch is closed in such a manner that the lamp can be illuminated merely by a slight pressure upon the tumbler. It is obvious that such a baton has elements of value superior in some ways to the customary police whistles, as means of communication between members of the police.



General diagram showing the application of paper-tape control to a machine for cutting cloth

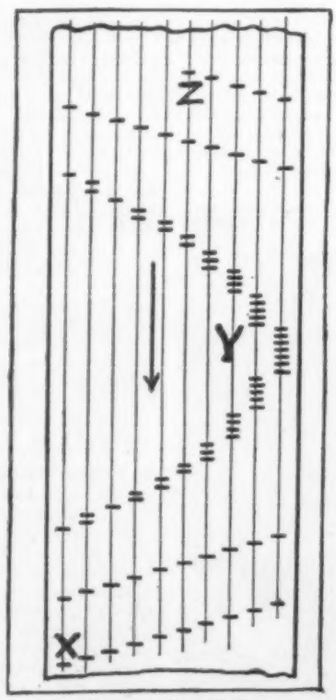
When Perforated Paper Goes to Work

How Strips of Paper Can Endow Inanimate Machines with Brains of Their Own

By Emanuel Scheyer

WHEN the subject of power comes up for discussion, attention is usually centered about the source of the energy for our present and future requirements. This is all very well, for unless we know where our energy is coming from, we need indulge in but little worry as to what we are to do with it. But assuming that our wants are to be filled, in one way or another, it is rather in order to examine the question of what we are to do with all this power for which we are calling upon the coal mine, the oil well, the waterfall, perhaps the tides and the rays of the sun, and, we hope some day, the very atoms that go to make up all matter. When we get it, what are we to do with it?

It is perhaps superfluous to say that the chief use of power is to create motion. It is not quite so trite to point out that the motion we are talking about is in practically every instance rotation. Our power is needed to drive something 'round and 'round; having got this something to go 'round, the problem arises of how to make the rotating member do work for us. We are not concerned in this discussion with the use of the rotating something to generate light or heat, or to obtain locomotion. But in a third great general application we are interested: our rotating power-producers are widely employed to drive tools and machines for the creation of manufactured articles.



A specimen section of the perforated tape

Operating a machine, after all, amounts to applying one's guidance intelligently to the control of the motions of the machine's parts. The great bulk of the men employed in industrial occupations is concerned with doing just this thing. Therefore of equal importance in the conservation of human effort, as in the generation of power, is the devising of means for the automatic operation of machines.

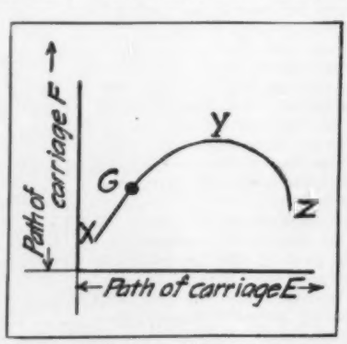
To the unlettered savage, it seems hardly credible that a few mysterious marks scratched on a bit of bark can act as the agency through which one man may direct another many miles distant, imposing his every desire upon the actions of the other. To us today it is almost as inconceivable as this, what a part marked or perforated paper will play in the industry of the near future. The time is coming when workmen will be largely supplanted by such strips of paper; when a walk through a factory will disclose hundreds of machines in operation with a mere handful of attendants fussing about. In some uncanny way, things will seem to be running themselves, very much as in the hoary story of the Chinaman, who, seeing for the first time a trolley car passing up the street, exclaimed: "No pushee, no pullee, no sabe how him goee?" A closer inspection of the machines would disclose how "him goee." Kinautograph mechanism would be attached to the various machines and rolls of perforated paper would be seen unwinding from some spools and on to others.

The kinautograph is a mechanism that will do for motion much the same thing that the phonograph does for sound. Just as in the phonograph, when you talk, a record is made of your voice which you can reproduce at will, just so in the kinautograph, if you put any given machine through its motions, a record is simultaneously made of these motions which will afterwards reproduce the original motions at will.

Once a record is made, the machine can be made to repeat its operations over and over again, and just as an automatic piano can be used to play an unlimited number of different musical compositions by using different records, just so the kinautograph can be used to perform unlimited sets of different operations. The making of a record is very simple; the handles of the machine are grasped and the machine put through its motions, which causes a perforated paper record to be made of these motions. Upon reversing the process, the machine will automatically reperform these motions.

A typical example of a machine operated on the kinautograph principle is the kinautograph cloth-cutting machine. This machine will cut up fabrics into shapes ready to be sewn into collars, shirts, underwear, overalls and clothes. Not only is the cutting of every yard of the millions of yards of the fabrics entering into these garments done by hand now, but the pasteboard patterns must be arranged by hand on top of the pile of fabric and then marked out, after which the goods are cut. With the kinautograph control, it is only necessary to spread the goods upon the table, insert a record into the control mechanism at one end, and start the machine, when an electric cutting tool will travel about the table by itself, just as if guided by hand, and cut up the goods into the shapes called for by the record. One attendant in charge of a group of these machines can turn out as much work as a dozen workmen can do now.

Our large drawing illustrates this application. The record box can be seen at the far end of the table. It contains a perforated record and other mechanism somewhat similar to that of automatic player pianos. Two electric cables lead from this box, one running on the floor under the table, and the other running overhead. The cables lead to tool-moving mechanisms, and the tool itself is shown. It consists of a thin blade of steel which is caused to jig up and down at a high rate of speed, and hence when moved through the fabric easily cuts its way. The tool-moving mechanism travels on tracks running lengthwise, one on each of the long sides of the table. Traveling on cross-tracks that form a part of the tool-moving mechanism is a secondary carriage to which the tool is attached. The tool-moving

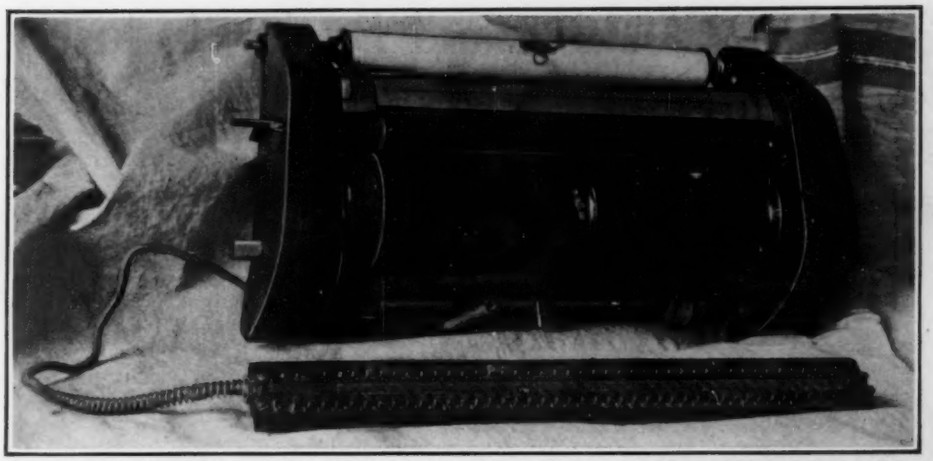


The path of the cutting tool as controlled by the tape-section shown at the left of the page. The points X, Y, Z in the two diagrams correspond

mechanism can travel back and forth on the cross-tracks across the width of the table. The combined motions of the tool-moving mechanisms enable the tool to be moved about so as to cut out any shapes desired, it being understood that the tool is always rapidly jigging up and down, as it is carried about. The motions of the tool-moving mechanisms are electrically controlled in accordance with the way the perforations follow each other on the record as it unwinds, the arrangement of these perforations being such that the tool will be carried about to cut out the required shapes.

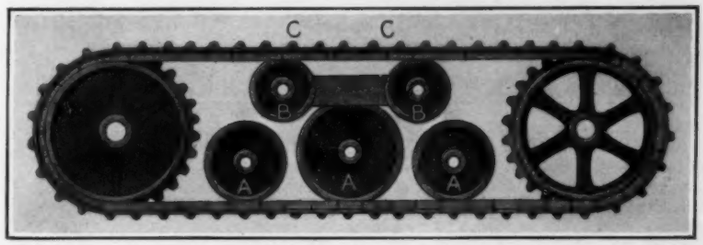
The motion of the cutting tool as it travels about the table is split up into its components as it is possible to do with any moving body. One component is its motion lengthwise along the table, taken care of by the main carriage, and another component is its motion across the table, taken care of by the cross-carriage. These components have been termed unit-elements. If one understands the unit-element, one understands the kinautograph as applied to any machine. The control of a machine is accomplished by one or more unit-elements acting at the same time, the mechanism of each unit-element of a machine being practically a duplicate of all the others.

This will be perhaps a little clearer when it is explained just how the perforated paper acts upon the machine. In general terms it works through the opening and closing of electrical circuits; but this is again too general to be strictly informative. For better details reference must be made to the photograph in which the paper record is shown at the top, rolled about its spool. Directly beneath this will be noted a flat metal plate, pierced by a row of holes extending clear across it. The paper as it unrolls from its spool passes across this plate and therefore across the holes. The latter are really the ends of a series of tubes, which lead to a corresponding number of small air-cells covered over with thin leather diaphragms. Each tube with its air-cell is connected to a suction pump. Individual tubes cannot suck in any air when a solid part of the record is passing over them; but when a perforation in the record comes over the end of a tube, the air rushes in through the tube to its corresponding cell and puffs out the diaphragm of the latter. Each diaphragm is arranged to puff in and out against metallic contacts which open and close an electric circuit, there being an air-cell, a diaphragm, a pair of contacts, and a tube for each of the binding posts shown on the board at the bottom of the picture. The lines of perforations in the record are arranged to slope to the right or to the left. As the perforations pass over the row of holes the air is sucked into succeeding holes, the uncovered holes from one instant to the next running to the right or to the left, depending on the slope of the lines of perforations passing over them. The tool-carrying mechanism is so designed that, as the circuits closed by the holes succeed each other to the right, it is moved to the right and when the circuits succeed each other to the left it is moved to the left, the speed of this motion depending on the slopes of the lines of the perforations. The nearer these lines approach the horizontal across the sheet the faster is the motion. At the point marked Y in the illustration of the record, where the line of perforations is vertical, the motion is zero. Response to the making and breaking of the circuits is naturally not instantaneous; but the mechanism is so arranged that the circuits are caused to interact one upon the other to compel the lag to be kept always within permissible margins of error for any class of work to be performed by a given machine.



The tape-roll, blower tubes, electrical unit, etc., for the control of automatic machinery as described in the text

The kinautograph, whose operation we have just described, is in fact a development of a previous invention of Jacquard, a countryman and contemporary of Napoleon. This device, named after its inventor, is frankly an intermittent affair, where the kinautograph is, within the limits imposed by the inescapable lag, continuous. The Jacquard has been used for many years in the control of machines where a step-by-step motion is sought. A good example is a particular type of automatic embroidery machine, where the frame carrying the fabric is shifted from side to side between each stitch. The successive shifts are not through equal distances, nor is the cycle of repetition a short one; if either of these conditions were present it may be assumed that an ordinary cam control would be adequate. But the kinautograph is now driving similar embroidery machines, on which the fabric-carrying frame is kept in continuous motion, while the needles are in constant operation instead of being obliged to wait for the next stitch until the fabric is in the right position. The result of this advance is that practically the same embroidery machine on which the Jacquard works with a speed of 100 stitches per minute may be driven by the kinautograph at six times this speed.



The rolls *A* are necessary to support the tractor, and the rolls *B* to support the track links *C*. The belt of the new tractor is so constructed that all such rolls and idlers are eliminated. It is claimed that a weight of twenty tons could be placed at *C*, and the belt would not spring down

The feature of the track-layer which is done away with in the new model

The lathe, the most important tool used in the production of articles of metal, is ideally adapted to control by the Jacquard; even more so, perhaps, than by the kinautograph. Under ordinary procedure large and complicated pieces can be turned only on hand lathes. But by adding a Jacquard to the assembly, the paper record, instead of playing a waltz by Chopin, can just as easily turn out a steel car-axle. In this application the holes in the record cause lathe stops to become operative at chosen times, and in addition actuate pneumatic cylinders for throwing in and out clutches which control the motions of the tool carriages against these stops. The reason why the intermittent control of the Jacquard is so well suited to this machine is because the cutting tool must be moved only periodically; after having been placed in the correct position for the next cut, and after the clutch has been thrown in to make the work rotate under the tool, nothing more in the way of control is necessary until the cut in question has been finished and another shift is in order. This plainly calls for intermittent rather than continuous control, and the Jacquard is apparently the logical means of securing it.

The possibilities of the kinautograph are far from adequately explored. Automatic dolls or manikins are marvelously adapted for control in this manner. What an interesting vaudeville stunt it would be to have two men dressed exactly alike, walk and turn about the stage doing their act, one being a ventriloquist, and have it all finally end by the real human being opening the other's coat and disclosing a perforated record and a lot of gearing. Since time immemorial men have endeavored to construct automata. Literature is full of stories of the making of statues or men of clay and imbuing them

(*Continued on page 445*)

The Rigid Track-Layer*

A NEW tractor just devised in San Francisco represents an effort to get away from the necessity for supporting the traction belt on machines of the track-layer type. It has always been necessary, on these machines, to employ trucks, rolls or idle wheels to support the track and to take up the weight of the tractor itself at moments when only a small length of the track was in contact with the ground. In general terms, the means by which this necessity is avoided is through the provision of a belt that shall have a sufficiently rigid frame to distribute the load of the machine to the entire portion of the belt that is in a position to take any of it, rather than the concentration of this entire weight on a few links or joints at a time.

Thus the strain or pull is transmitted from link to link through heavy, wide-faced lugs, acting through interposed pivot rings. All movement in the joints between the links is eliminated except when they leave the front sprocket and rise on the rear sprocket, the intermediate ground portion and the corresponding bridged portion above it being as rigid as a continuous bar. It is claimed that in thus supporting the load without track rollers an improved rolling effect is attained, with a greater percentage of applied power and the elimination of a great deal of the usual friction.

The rigid-belt track-layer in action. Note how the upper section of the track stands rigid

The Dry-Cleaning and Dyeing Industry

Some of the Interesting Technical Problems that Have to Be Met

By Lloyd E. Jackson

Senior Industrial Fellow of the Mellon Institute of Industrial Research of the University of Pittsburgh, Pittsburgh, Pa.

The garment-dyeing room

The wet-cleaning department

The dry-cleaning washers

Three typical scenes in a modern cleaning and dyeing establishment

DRY-CLEANING is the removal of dirt and stains from material by means of solvents and specially prepared soaps. The term dry-cleaning is used in contradistinction to cleaning with water and soap. After being wet with water, many textile materials cannot be made to assume their original shape; the finish is often impaired; and delicate colors are affected so that wet-cleaning is not practicable. By means of proper solvents and detergents, such materials can be cleaned so that the shape is not changed, while the color is often brightened.

A distinction must be made between competent dry-cleaners and those who do not use efficient methods or have the proper facilities. Thousands of places represented to the public as cleaning establishments have no right to be classified as cleaners at all. Many of them carry out their crude operations in cellars or sheds or back rooms, in open washers or on scouring tables, and send to better equipped plants the part of their work which cannot be made presentable by these superficial methods. It is estimated that there are 200,000 such places in the United States and Canada. To a large extent their "cleaning" process consists merely in saturating the article in gasoline that has been in use for a sufficiently long period to lend certainty that it is itself far from clean. One can readily understand that garments or other articles treated under these conditions are not cleaned.

Few people realize the extent of the service which the skillful dry-cleaner provides. He cleans suits, overcoats, raincoats, leather coats, all kinds of fur pieces and coats, fancy dresses of the most delicate materials, women's hats, feathers and plumes, gloves, fancy shoes, neckties, and any other kinds of clothing or millinery; rugs, blankets, comforters, upholstered furniture, lace curtains, shades, draperies, automobile upholstering and seat covers, and lamp shades. Rugs which are loaded with dust and grease are dry-cleaned and are returned to the sender fresh and clean. Furs are thoroughly cleaned and, upon request, returned to the customer in moth-proof packages suitable for home storage. Fur is as soft and lustrous as new even after 150 dry-cleanings, more than it would be subjected to during its wearing period. Moths are removed not only from furs, but also from other materials containing them which may be submitted for proper cleaning.

The two cleaning agents used in largest quantities are dry-cleaners' soap and either gasoline or benzol. These agents are supplemented by alcohol, acetone, carbon tetrachloride, acetic acid, bleaching agents, etc., which are used mostly for removing spots that do not respond to the ordinary treatment. Dry-cleaning soap is a super-fatted soap, soluble in gasoline or benzol, in which about one-half of the fatty acid has been saponified with caustic potash or caustic soda or ammonia.

The procedure for cleaning men's and women's suits, used by well-equipped, properly operated plants, is typical of the practice in dry-cleaning wearing apparel. A cylindrical washer is generally used, consisting of two horizontal metal or wooden cylinders, one inside the other. The inside cylinder revolves; the stationary outside cylinder acts as a reservoir for the cleaning solvent. The inside cylinder is either perforated or made of slats spaced so that the solvent contained in the outside cylinder may pass freely into it. It is about six inches smaller in diameter and length than the outside cylinder, and is supported by trunnions and revolved mechanically. The solvent is charged into the washer so that there is a depth of ten or twelve inches in the outside cylinder. The garments are placed in the inside cylinder and this is revolved, first a few turns in one direction and then a few turns in the other. The garments are run for five minutes in straight solvent, then the solvent is run off and fresh solvent put in, to which dry-cleaning soap has been added. The quantity of soap varies with the degree of soil in the garments, an average figure being one pound to fifty gallons of solvent. The garments are run for thirty minutes in this bath. They are then rinsed once or twice with fresh solvent, five minutes being required for each rinse. They are then centrifuged, and finally transferred to a drying tumbler, where they are run for thirty minutes to remove the last traces of the solvent.

The drying tumblers are of metal and are designed along somewhat the same lines as the washer. The drying is hastened by a current of heated air blown through the tumbler. After the garments are dry they go to the spotting table, where attention is accorded to any "sweet" spots which may not have been removed in the process just described—so called because they usually are caused by sugary or starchy materials which are insoluble in gasoline or benzol. Many of these spots are easily removed by brushing or by means of a sponge dampened in water, the greasy vehicle serving as a binder having been removed by the gasoline or benzol. From the spotting table the garments are taken to the finishing department, where they are steamed and pressed, after which they are ready to be packed and returned to the customer.

Silk garments, draperies, etc., are treated in a similar manner, except that they are accorded more care, to prevent tearing. Delicate silk dresses are placed in cotton bags before being entered in the washer. Rugs are first placed on a specially constructed floor and blown with compressed air, to remove as much dust as possible. They are then put in a large washer and cleaned by a process similar to that used for cleaning garments. Gloves are cleaned in small cylindrical washers and subsequently are dried on racks in a current of warm air.

There are some classes of work which cannot be cleaned in a washer—lamp shades and very delicate draperies, also articles which are too dirty for ordinary treatment. These are brushed clean with scrubbing brushes, gasoline and dry-cleaning soap. For some of this cleaning considerable skill is required to clean the material evenly, to prevent shifting the weave of delicate fabrics, etc. The more delicate classes of work cannot be dried in drying tumblers, but must be hung in ventilated, heated drying rooms.

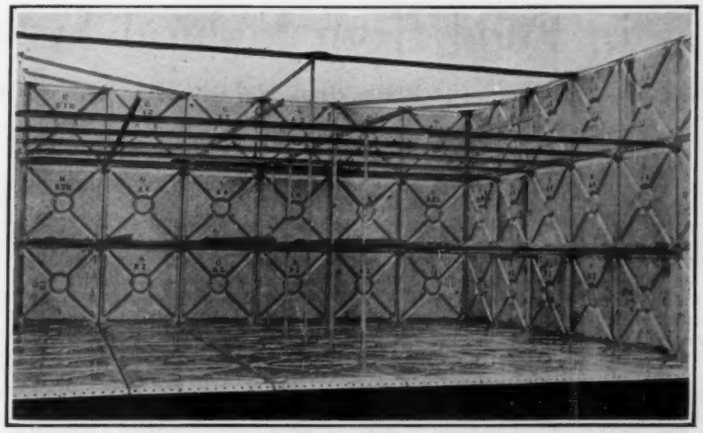
In all cases the cleaning solvent is drained into a sump, from which it is pumped to settling tanks. In some plants the dirty solvent is redistilled; in others it is washed with caustic soda solution and allowed to settle. The solvent is used over and over again, new solvent being added to make up evaporation losses. It takes a stock of several thousand gallons

Research laboratory of the International Technical Society of Cleaners and Dyers, located at the Mellon Institute in Pittsburgh

(Continued on page 445)

Large Portable Water Tanks

IN engineering works, in the field, and on railways it is sometimes necessary to provide temporary accommodation for the storage of considerable quantities of water, although ultimately the necessity disappears and the accommodation is required elsewhere. In cases where the storage is permanently required, tanks consisting of steel plates riveted together and caulked, or reinforced concrete reservoirs, are provided, but these are obviously unsuitable for removal and re-erection, while tanks made of cast-iron plates bolted together are open to the objections of weight and liability to breakage. To overcome the difficulty, tanks built up of pressed steel flanged plates bolted together are often employed, possessing the advantage that they can readily be taken to pieces and transported, or that they can be reduced or increased in size at any time according to requirements. There are only five different types of plate, and all the plates of each particular type are interchangeable, the flanges being drilled to a standard gage for the connecting bolts. Between the flanges thin strips of lead are inserted before bolting them together, molten lead being poured into the corners to make water-tight joints. Each plate measures four feet square and is five-sixteenths of an inch thick and thoroughly galvanized, as also are the connecting bolts. The plates are pressed in the form shown to increase their resistance to buckling. The illustration above shows an interior view of a pressed steel tank measuring 24 feet square and 12 feet deep. Of course, this view is inside a partially erected tank, showing the method of staying the plates with galvanized stays against water pressure inside the tank. The idea is a British one.



Portable water tanks in use on the Argentine railways where water storage in the field is something of a problem

American Trade-Marks in Germany

COUNTERFEITING of American trade-marked razor blades, which has been extensively practiced in Germany, received a heavy blow in the recent termination of a case that had been pending for a year or more. A fine of 70,000 marks was imposed, and the court announced its determination to deal with parallel severity with further cases. There has been a deal of imitation of standard American goods, and the present decision clears the air considerably, and gives assurance that this infringement is not with the actual passive consent of the authorities.

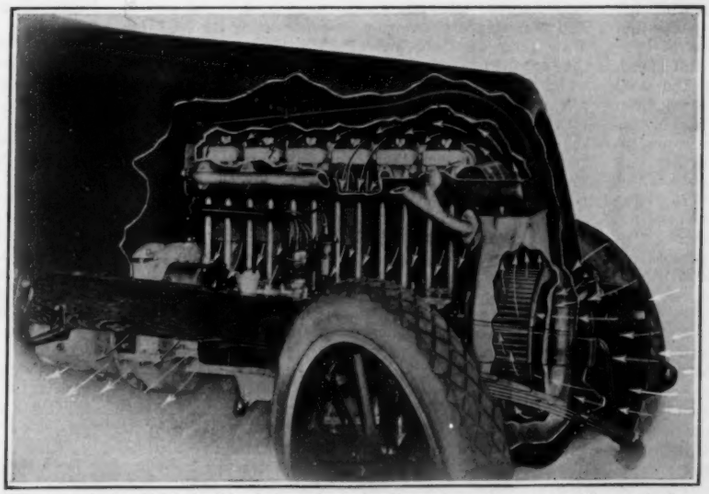
The Air-Cooling of 1923

THE much-advertised new motor on the leading American air-cooled car possesses a number of features of more than the mere passing interest which the blasé automobilist usually accords an announcement of "a new motor." Perhaps the most radical departure is the replacement of the flywheel suction-fan at the rear by a blower at the forward end. By careful attention to the design of the fan, the air passages, etc., the result is attained of circulating 2.5 times as much air through the cooling jackets at given speed, yet with a material reduction in the power consumption of the fan. The large open grill at the front of the hood permits the passage of four times as much air as is used for the blower; the excess being used to cool the outer edges of the cylinder fins, and the aluminum crank-case which receives its heat from the oil. The hot air from the blower is diluted and cooled by this stream in such a way that the average temperature of the air that passes under the car is but slightly above atmospheric.

As before, the cylinders are cast separately. Cylinder and head are a single casting. A clever turn of the fins does away with the necessity for a separate outer jacket, and reduces the center-to-center distance of the cylinders; so that the new engine is of simpler design and more compact than its predecessor.

By the use of duraluminum the connecting rods have been materially lightened, the figures being 1.25 pounds for the duraluminum rod with die-cast end, as against 2.2 pounds for the steel rod formerly used. The weight of the piston, with rings, pin, and pin-retaining ring, is only 1.394 pounds, giving an extremely low weight for the reciprocating members of the engine.

The carburetor is provided with a dashboard adjustment for the needle valve which permits of adjusting for rich and lean mixtures while driving; with a tickler which enables one to determine whether there is gas in the carburetor without doing any dirty work; and with an electric vaporizing and superheating apparatus which is claimed to give a sure start with at most ten seconds of cranking in a 20-below-zero temperature. This saves something like 82 per cent of the battery energy ordinarily required for starting at this temperature; and no owner needs to be told what that means in longer life of the battery. Among other items worthy of mention is an idler gear on the transmission, provided mainly for driving the tire pump.



Engine of the 1923 model of America's leading air-cooled car, with particular reference to the direction of the air currents

Power Loss in Automobile Tires

THE Rubber Laboratory of the Bureau of Standards is equipped with a special dynamometer for measuring, among other things, the power loss in automobile tires. The principal elements of the dynamometer consist of an electric motor for driving the wheel and tire, and a pulley which bears against the latter and in turn is connected to a second electric generator. Both the motor and generator are arranged so that the torque may be measured, and it is, therefore, easy to determine the power input and output. The difference between the two readings will, of course, be the loss of power on the tire. This loss varies with different tire constructions and inflation pressures.

Many of the standard makes of tires have been tested on this dynamometer and valuable data are being obtained concerning the percentage of power of an automobile engine which is largely dissipated in the form of heat in the tires. Recently some preliminary figures have been obtained concerning the extent to which different parts of the tires contribute to the power loss. From these it is estimated that 80 to 85 per cent of this loss is in the carcass, the tread contributes 10 to 15 per cent, and the tube probably less than 5 per cent. Indeed, there is still room for improvement in tires.

A Five-Million-Dollar Train Load of Silk

WE show herewith a photograph of a very remarkable shipment of freight from the Orient, which was carried in a special train and made the trip unbroken from Seattle to New York. For transporting the silk, no less than fourteen cars were required — these being express and baggage cars measuring from 60 to 70 feet in total length. The weight of the train was 1325 tons; and the time consumed in making the whole trip from Seattle to New York was 100 hours, or about four days. A remarkable feature of this train was that the actual value of the silk shipment was five million dollars; and since this precious load was to be carried clear across the continent, at a time when there was a positive crime wave of robbery and hold-ups of valuable shipments by motor truck and train, it is needless to say that special precautions were taken to safeguard the shipment.

The five-million-dollar silk train that went across the continent without breaking bulk

Thermal Stresses in Chilled Iron Car Wheels

TECHNOLOGIC Paper No. 209 of the Bureau of Standards describes the investigation completed a short time ago on thermal stresses in chilled iron car wheels. This circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy. This work has been previously referred to in the SCIENTIFIC AMERICAN and is regarded as very important by the wheel manufacturers and the railroads.

The paper describes a method for testing car wheels in the laboratory under conditions approximating those encountered during heavy brake application in descending long mountain grades. In these tests the wheels were heated by passing an electric current through a band of iron encircling the wheel but electrically insulated from it. The resulting stresses were calculated from strain gage measurements after correcting for thermal expansion. Twenty-eight wheels of varying weights and designs from three manufacturers were tested in this manner, of which 16 failed by cracking in the plate. The maximum stresses developed are very close to the tensile strength of the cast iron and occur in a radial direction near the junction of the double plates in the Master Car Builders or Washburn type of wheel. In the arch plate type the maximum stress is somewhat nearer the hub. The paper also covers the properties of the wheels tested.

Millions in Food from Federal Free Seed

The Story of 240,000 Acres of Gardens, and $192,000,000 Worth of Vegetables

By George H. Dacy

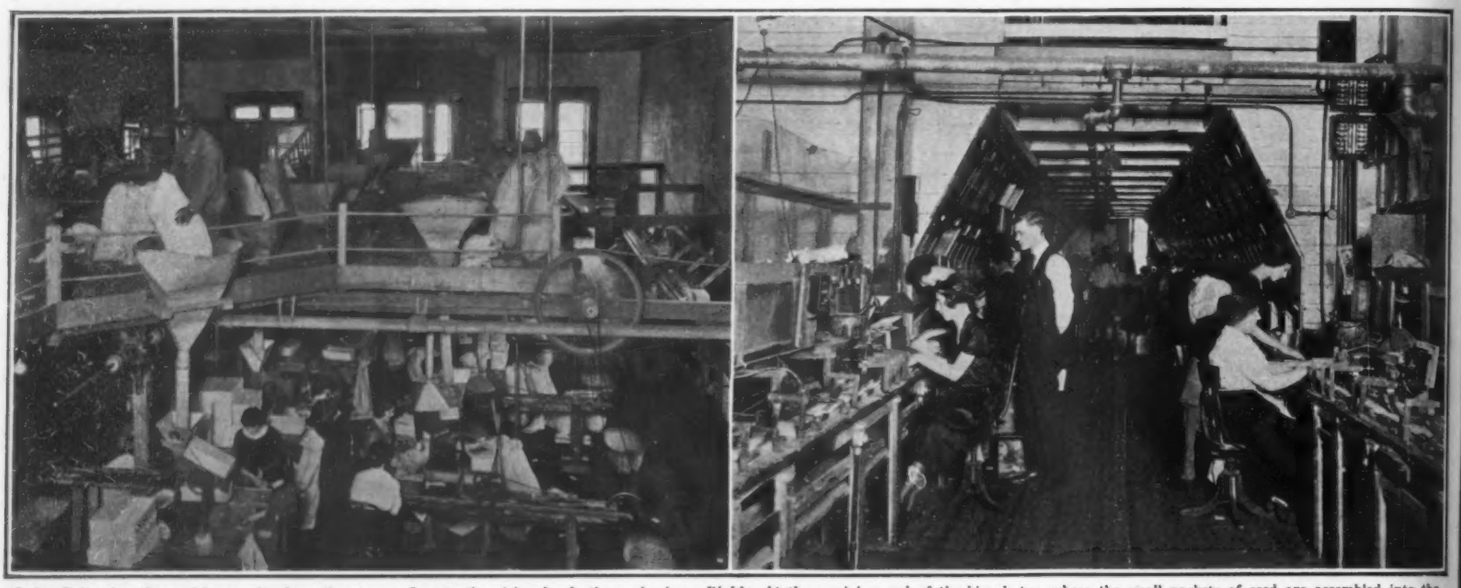
THROUGH his Congressmen, Uncle Sam annually gives away approximately 65,000,000 packages of vegetable and flower seed—the best seeds of their type and variety which are to be had in the world. All the Government free seed is tested for germination and trueness of type before it is disseminated among the amateur and professional gardeners, farmers and suburbanites here, there and everywhere throughout the United States. Ever since the inception of Uncle Sam's annual free seed party, commercial dealers and the general public have ridiculed the free federal seed as cheap, impure and generally "no account." Despite this, the demands for the free seed have increased. Our Representatives and Senators are swamped with applications for the large franked envelopes, each of which contain five packets of certain combinations of seed. The gardeners have tried out the seed and found it the best they ever used. They come back for more each season because they know that the only source from which they can obtain such superior seed is the Department of Agriculture.

hundreds of thousands of letters which pour in from the highlands of Appalachia, the wildernesses of Maine, the deserts of Arizona, the cut-over lands of Wisconsin and Michigan, and wherenot in the United States. Our federal lawmakers always reserve five-sixths of the seed for distribution among their constituencies. The remainder is allotted to the Department of Agriculture as an emergency seed supply which may be given to regions where weather conditions have been severe to the extent that their original quotas of free seed did not germinate.

As matters stand at present, each Congressman is entitled to 20,000 packets of vegetable seed and 2000 packages of flower seed which he can distribute among the gardeners of his district. Needless to say, all the national lawmakers avail themselves to the full limit of their available quotas of seed. In fact, the Department of Agriculture has to keep a very accurate set of books on the seed debits and credits of each Representative or Senator. At the beginning of the annual seed distribution each Congressman is credited with his just proportion of the Government seed on the books

to prevent germination, a return of at least $10 per packet of seed in food products has resulted from the averages compiled from 20 years of accurate records kept by Uncle Sam.

Those who use the federal seed from Maine to Florida and from California to Pennsylvania by the hundreds of thousands indorse it as much better seed than they are ever able to buy on the local markets. The Government seeds germinate well and grow and produce bumper yields of vegetable crops. "Government seeds are the only ones on which I can always rely," writes a gardener from Mississippi. A Representative from Texas who last year personally made a garden and grew vegetables reports that his federal seed gave excellent results, germinating well and being admirably adapted to the climate of the Lone Star state. A school-girl from a corn-belt state last season raised $20 worth of fine vegetables from one of the small packets of Government seed. An amateur gardener in Providence, Rhode Island, produced $50 worth of vegetables from his large envelope of Government seeds. He won a prize offered by the local merchants'



Left: Delivering the seed by gravity from the storage floor to the girls who do the packaging. *Right:* At the receiving end of the big chutes, where the small packets of seed are assembled into the larger, franked envelopes

The machinery of distribution of the seeds that Uncle Sam gives away each year

The hives of the busiest bees look like centers of idleness as compared with the Government seed warehouse during the period from October to April each year, when the work of sampling, testing, packeting, enveloping, franking and mailing the millions of Congressional orders for seed is progressing at full speed. It is a well-planned orderly journey that the seed travels, from the gunnysack in which it came from the seed dealer to the franked package in which it is sent out by a Congressman to one of his rural constituents. There is no lost motion. The operations are all standardized and systematized. As far as possible mechanical appliances have been substituted for hand labor. One hundred and fifty girls and women are employed. They operate simple and efficient machines which expedite the rapid transfer of the tested seed from large sacks to small paper packets and finally to the mailing of five packets of the seed in one large franked envelope to the ultimate user.

For many years the Department of Agriculture has been opposed to the congressional seed project, as it is called. The federal farming experts claim that the $360,000 which yearly is spent in buying seed and sending it to all sections of the country could better be expended in securing from foreign countries new and rare seeds and cuttings of plants which appear to be adapted for cultivation under our climatic and soil conditions. But annually Congress overrides the recommendations of the Department and adds the free-seed item to the agricultural budget in answer to the

of the Department of Agriculture. Henceforward he is permitted to draw against this quota as if it were a bank account until his allotment of seed is exhausted. The persistence with which Congressmen try to overdraw their accounts indicates the great popularity of the officially inspected and guaranteed garden seed which Uncle Sam gives away.

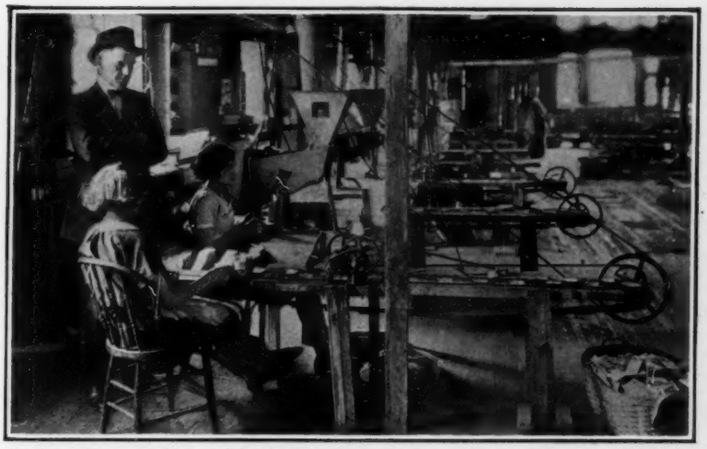
Banks, merchants and agricultural clubs the country over which have aided the respective Congressmen in the distribution of their seeds, have kept tab on the resultant returns in the way of foodstuffs which emanate from this generosity of the Government. The average of innumerable reports shows that the representative acre of garden planted with federal free seed yields at least $800 worth of foodstuffs. A leading bank of Grand Rapids, Michigan, reports acre yields of vegetables worth $1200 from the free seed gardens under its patronage. Last year more than 240,000 acres were planted with Government seed, which demonstrates a food production worth $192,000,000. It's a pretty good investment that Uncle Sam makes in his farm and garden seed donations. He spends $360,000 in buying and distributing the seed and the gardeners grow $192,000,000 worth of vegetables and truck crops. If any other government or private philanthropy in the country in a single year can yield a return 533.3 times as great as the initial investment, the writer would like to know about it. Even under the worst possible conditions where one-third of each packet of seed was wasted, damaged in transit or otherwise injured so as

association for the best home garden. A couple of old-timers in Hamilton, Ohio, won a $50 prize from their backyard garden, the superiority of which they attribute to Uncle Sam's faultless seed. Enthusiastic indorsement of the free seed has come in hundreds of letters from Detroit automobile mechanics and cotton-mill employes of the South, as much seed is annually distributed among the working forces of such establishments.

Approximately 30 different combinations of seed have been worked out which are adapted to production in different sections of the country. For example, some of the vegetables which will flourish in Florida will fail in Minnesota. The superintendent of seed distribution studies the orders of each Congressman and makes sure that combinations of seed are sent out which are propitiously adapted to cultivation in the section of the country where the seed are destined for distribution. Naturally, city residents cannot plant vegetable seed unless they have backyards. However, most of them can put out window boxes seeded with flower seed. Hence there is a special proviso by which Congressmen can exchange a certain proportion of their vegetable seed for flower seed for distribution in congested city sections.

In addition to being tested for germination, all the Government seeds are tested for trueness of type and name by planting some of them in the gardens of Uncle Sam's big experimental crop farm at Arlington, Va. All seed that does not germinate up to federal require-

ments is rejected, while if any dealers provide seed which is not true to name they are blacklisted and boycotted so far as potential national purchases are concerned. Just to illustrate that this factor is one of crucial importance, it is mention-worthy that there are more than 1600 different types of lettuce, 2000 different varieties of radishes and 1800 different kinds of beans grown and sold commercially throughout the United States. American seedsmen catalog this number of varieties, and although Uncle Sam does not recognize all of them officially, he has to know them and their aliases in order to determine what sections of the country they are adapted to. It is especially notable that during the last score of years, during which Uncle Sam annually has distributed from 100,000 to 1,500,000 pounds of seeds, the official tests of the federal free seed have averaged over 89 per cent—a record altogether remarkable. During the past twenty years between 30,000 and 50,000 pounds of Government flower seed have been circulated among the public each year. Opponents of the free seed distribution measure yearly raised a great hullabaloo concerning the large Post Office deficit that results from the fact that the free seed is sent out under Congressional franks. These contentions are wholly unfounded. Records kept by the Department of Agriculture show that during the last twenty years the average cost of handling the Government seed if it were distributed by a retail seedsman would have ranged from $55,000 to $130,000 a year, with the average about $110,000. This includes the true cost of postage on the basis of the actual weights of the large and small packages of seed. This would at best be but a small item to the Post Office Department. Furthermore, the system of handling the seed has been so standardized that the labors of the federal mail service is reduced to a minimum.



Seed-packing machine, with the inventor and the crew of two girls who hold the record for making up and sealing 48,200 packets in a day

The seed packages have to be prepared and circulated on a rush-order, full-pressure schedule. By law it is required that no seed be put into the mails before December 1, and that the distribution of seed by Congressmen be completed by April 1. The Secretary of Agriculture is allowed the special privilege of sending out free seed up to April 15. During a short period of four months—on the basis of current activities—65,000,000 packets of seed placed in 13,000,000 of the large franked envelopes have to be put into the mails. The inception and perfection of mechanical hands to expedite this work have been of immeasurable importance.

The Post Office Department keeps from 5 to 12 clerks at the Government seed warehouse during the mailing season sorting and routing the Government franks—the substitute postage stamps—into the different towns and villages over the United States. This system eliminates much laborious work in handling the packages of seeds in the official post offices. For example, if Senator X of Georgia desires to send 1000 large packages of seed to political supporters of his in the town of Stark, the franks are prepared and viséed by the postal clerks at the seed warehouse. Then they are passed on to the large manila envelopes which, in turn, are filled with the desired combination of seed. When the packages are finally counted and placed in the mail bags, they are ready to go directly to the mail train which will convey them to their destination. The same number of postal clerks can handle 20 times as many packages in this way as they can of ordinary unassorted commercial packages. An ordinary mail pouch will hold 200 packages of Government seed. It takes 65,000 mail bags to carry the free seed supply from Washington to the localities where the gardens will be planted.

Gravity is harnessed as much as possible in aiding the big job of packing the seeds in paper envelopes. On the fourth floor of the seed warehouse are 22 galvanized iron hoppers, each holding about four bushels of seed. These feed seed to as many packets and sealing machines on the floor below. Mr. Frank Clarke of Waco, Texas, the contractor in charge of the packing, sealing and delivery of the seed packages during the current year, has invented a very ingenious sealing machine which has vastly aided in speeding up the work. Formerly it used to take three girls who worked by hand all day to fill and seal up 16,000 of the small packets. Now two girls working with a machine can fill and seal an average of 30,000 to 35,000 packages in a similar period. The record day's work has been 48,200 packages by two girls who worked at top speed and filled and sealed at the rate of over 100 packages a minute. One of the girls sits in front of a delivery tube provided with a revolving adjustable cup that deposits exactly the same amount of seed into each package. The other girl feeds the packets of seed (ranging in size from 8 to 1200 to the pound) into the gluing and sealing machine. This machine consists of an endless belt provided with a series of cleats spaced to fit the different-sized packets. It is operated by electricity. In turn, the packets are slipped into the spaces on the moving belt and carried under an automatic device consisting of a brass wheel which applies glue to the flaps and then under another special contrivance which folds over these flaps and presses them tightly so that the glue adheres and seals the containers. As the belt reaches the end of the machine and begins its downward and backward journey, each packet in turn is delivered to a large basket. When the basket is full, an attendant replaces it with an empty receptacle and dumps the filled container through a chute in the floor to a bin. There are as many different chutes and bins as there are different kinds of seed.

Sorting and arranging the unfilled envelopes before the franks are attached, and keeping track on each Congressman's allotment of seed

Altogether there are 64 of these V-shaped seed bins, which are large enough to accommodate 50,000,000 packets of seed. The 14 vegetables include beans, corn, peas, watermelons, cucumber, squash, parsley, lettuce, onions, radishes, turnips, tomatoes, carrots and beets. About 30 different combinations of these seeds are sent out. There are 10 different kinds of flower seed, including nasturtiums, sweet peas, petunias, poppies, mignonette, asters, cosmos, and the like.

On the second floor of the seed warehouse there are five large endless belts, each of which is manned by a crew of nine girls. Chutes from the seed bins above distribute the different kinds of seed respectively before certain of these girls who feed the small packets of seed into the large envelopes which are carried along the belt. For example, the combination of seed may consist of beans, corn, peas, beets and lettuce. The franked envelope starts from the tables where girls paste the franks on to the proper envelopes. There it passes on belts to the next post, where the girl puts in it a packet of corn. The next girl slips in a packet of peas, the next one beets, and so on until all five of the required packets of seeds are placed in the envelope. Then it passes before another girl who inspects the package to see that it contains the right kind and number of seed packets. The final operator runs the machine that glues and folds the envelope flap. The large packages are delivered into baskets which are dumped onto tables before inspectors who count and check the packages and deposit them into the mail sacks, whence they go directly to the railroad.

Pasting the franks on the large envelopes. This is done after the envelopes have been addressed and sorted geographically, and before they have been filled

The five conveyor belts handle 125,000 large packages, or 625,000 small packets, of seed daily. The day's record for any belt is 36,600 packages, or 183,000 small packets of seed. The belt operates at a speed which carries 84 of the cleated spaces for the envelopes before each girl a minute. These large belts travel a combined distance of 2,555 miles in packeting and preparing the free seed for distribution. If placed end to end the 65,000,000 packets of seed distributed during 1922 would cover a distance of 3551 miles, or about one-seventh of the distance around the world.

And that is the story behind those large envelopes of seeds which come to us in response to our request.

The New Conservation—I

Up-to-the-Minute Definitions of Waste, and Up-to-the-Minute Procedure for Preventing It

By Ray M. Hudson, Division of Simplified Practice, U. S. Department of Commerce

"POOR RICHARD said many years ago, "A penny saved is a penny earned." One of the quickest means for increasing output in a factory is cutting down the "seconds," or the spoilage, more commonly called "scrap." Plant managers for years past have concentrated their energies on utilizing "all of the hog but the squeal," and as a result we have grown so accustomed to the reports about our highly efficient industries that we take a lot for granted. In fact, too much! When the committee of eighteen leading industrial engineers turned in its report, "Waste in Industry," to the Federated American Engineering Societies, it opened our eyes to many things! The report might well be called "The Alarm Clock of American Industry," for ever since its publication, more and more industries have awakened to their true responsibilities, and thus to their broadest opportunities.

Surprisingly enough, many of those plants noted for their high material economies, and their refinements of manufacturing processes, have found their vision so obscured by the "penny savings" they were missing the dollar profits that lay beyond. The real cause for this myopia, however, was in the individual interpretation of "waste"—the common practice being to consider it principally from the material point of view. Its significance as an economic problem was relatively unappreciated. Careful study of the engineers' assay shows the new principle in industry is conservation, or economy, carried to a maximum. Not merely of material, and time, but of human energy!

In the "New Conservation" we find an expression of broadened meaning, and enlightened vision. It is used here to describe a fundamental economic principle, which in the cumulative effect of its mass-application, marks a great forward step not only in the development of our industries, but also in the advancement of our standards of living. One great reason for the present comparatively low purchasing power of the dollar is that we have been too profligate with our resources. Individually considered, our industries are highly efficient, but taken as a whole, the average efficiency is only about half what it should be. The report shows a collective waste of over 40 per cent of our energies and resources. A graphic picture of the wasted 40, in Secretary's Hoover's own words, reads: "We have probably the highest ingenuity and efficiency in the operation of our industries of any nation. Yet our industrial machine is far from perfect! The wastes of unemployment during depression; from speculation and over-production in booms; from labor turn-over; from labor conflicts; from intermittent failure of transportation and supplies of fuel and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials, all combine to represent a huge deduction from the goods and services that we all might enjoy if we could do a better job of it."

In characteristic engineering manner, the report goes into the underlying causes and shows that over 50 per cent of the responsibility for the wastes found in the six major industries assayed rests on management. Less than 25 per cent is chargeable to labor, while the amount chargeable to outside contracts, *i. e.*, the public, trade relationships and other external factors, is least of all. But what are we doing about it?

True engineering requires that the recognition of a defect involve the responsibility of, and for, its correction. Now that the relative waste has been determined through this cross-section of typical American industries, we can't stop there! It's high time for action, and we want results. If there is any one thing in which we Americans take great pride it is in our ability to "get action when action counts most." And so we find group after group analyzing the operations and studying the facts of the industries each represents. They find that production statistics alone do not tell the whole story, not by half. Distribution of the product is equally important and the entire range of activity from initial producer to ultimate consumer is being charted, studied, and microscopically examined for those weaknesses that are always deadly, because concealed. This is a time of great opportunity, and yet of great hazard to our nation. The past few years have wrought an economic complex far more involved than any known hitherto. Abroad we have witnessed the destruction of the major sources of supply. Russia is no longer the "granary of the world." Industrial stagnation prevails in England. Reconstruction and political problems absorb French attention. Only in Germany is there a semblance of that great industrial activity that prevailed before the war. But watch Stinnes, the man who is busy organizing, merging and welding industries into a smooth working mechanism that is steadily, quietly, and persistently reaching out for the markets that the German Empire formerly enjoyed. The shift of trade channels in seeking for new sources of supply that made New York instead of London the trading center of the world, brought us the temporary position of leadership. I say, temporary, for we're none too sure we can hold the lead now that we have it. Unless—and there is the crux of the whole problem—unless we eliminate the wastes prevalent in our industries—unless we conserve our resources, raw material, labor and capital—unless we practice the utmost thrift and economy, industrially and politically, we're going to slip back, until we're checked in among the "also rans."

When foreign workmen, who, though we sympathize with them in their apparent lack of freedom, are always thinking in terms of their country's best good, and are working long hours for low wages, and who, with their capacity for deep national feeling, sigh and murmur "It is for France," "Vive La France," or "It is for the Fatherland," and then patiently resume their tasks; when men are so imbued with their national ideals that they will endure their present trials and hardships, and accept their lowered standards of living—we Americans can well afford to stop, look, and listen!

During and since the war, strikes of first one group and then another contributed largely to the total economic loss, notwithstanding the efforts to avert them, or to adjust them after they begun. Prices climbed skyward not entirely through scarcity of supply, or other economic cause. Buying stopped, industries closed down, business men failed, workers were unemployed—all these happened in plain sight of all of us, and yet we think we are efficient ,and go on cheerfully paying the bill! When we have learned that the whole is no greater than the sum of its parts, and that we can't have industrial stability until we have found the way to harmonize divergent groups, and recognize their interdependence; then, and not until then, can we expect the "wasted 40" to become any less.

Conservation is an old word, but Theodore Roosevelt and a score of other forward-looking Americans since his time found it had a broad meaning, and a wide application. Those men who formed the Conservation Division of the War Industries Board had a very practical conception of its relation to the big job of winning the war. Some of them even ventured so far as to request the work be continued as of national importance, and great economic significance, in the reconstruction period. But, as usual, it proved but another illustration of the old saying "A prophet is not without honor save in his own country." Even now with the "Survey of Waste" before us to substantiate the activities recognized as practical measures for our industries in the days when guns and ships were more needed than men, we find only a small percentage of our great population studying the findings. The only way to prevent losses in American capital, material, and resources, and keep out of bankruptcy courts is to study the facts of our industries, and then apply the obvious corrective measures such intensive analyses always suggest. The elimination of waste is the greatest industrial problem before our nation today, and so it will be every day for years to come, until we have learned to think in terms of the "greatest good to the greatest number."

The engineers tell us waste in industry is attributable to four major conditions:

1. Low production caused by faulty management of materials, plant, equipment and men.
2. Interrupted production caused by idle men, idle materials, idle plants, and idle equipment.
3. Restricted production intentionally caused by owners, management, or labor.
4. Lost production caused by ill health, physical defects, and industrial accidents.

They further tell us these wastes can be largely reduced, if not entirely eliminated (on the part of the management) by:

Improvement of organization and executive control.

More intelligent production control.

Better balancing of productive capacity with demand.

Correlation of production schedules with sales policies.

Better maintenance of plant and equipment.

Uniform cost and accounting methods.

Adoption of just and equitable methods of wage payments.

Standardization of product, materials and equipment.

Development of mutual interest in production on the part of management and the workers.

Prevention of accidents.

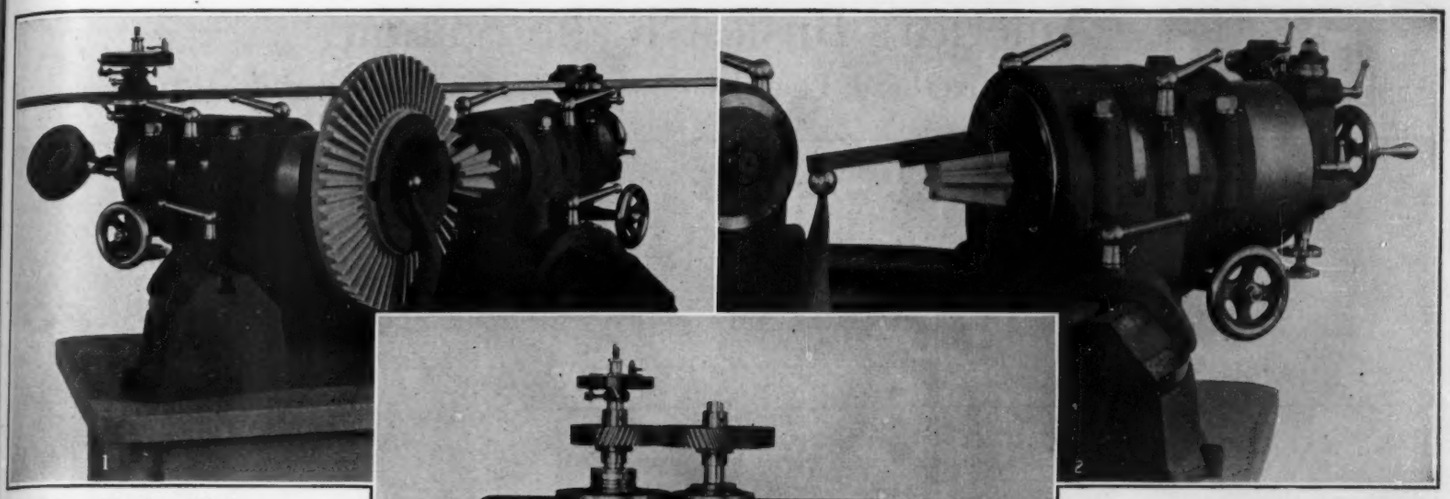
Research.

That is a tidy list of positive suggestions. Nothing high-brow about it, just plain common sense. There's enough meat in every one of them to satisfy every red-blooded American who, in any way, is in position to start some one of these corrective measures in his own sphere of activity and see it through to the finish.

Labor, too, can contribute much toward making the "New Conservation" a household word, and a family pledge—for every worker has it within his power to aid in eliminating the wastes for which he now pays so dearly. It is well known that workers, whether of hand or brain, or both, are by far the greatest consumers of good and commodities—but what should be equally well known is that when it comes to a question of who foots the bill for these great wastes "the ultimate consumer pays for it all." Since the workers are in the majority, they bear the heavier part of the waste bill. It shouldn't be so, of course, and it wouldn't be if management fully met all its responsibilities. But then labor can do much to help cut down the total loss. For example, the engineers suggest that labor cooperate more fully to increase the sum total of production; to prepare for and even demand the determination and use of performance standards; to change its rules regarding restriction of output, unreasonable jurisdictional classification and wasteful methods of work; for improving health and reducing accidents, and also

(Continued on page 446)

AS TO the desirability of eliminating waste there can be no two minds. Labor and capital, manufacturer and consumer, buyer and seller, banker and Bolshevist, will all agree on the abstract generalization. But when we try to get them to agree on the concrete, specific question of what constitutes waste, that is something else! Where do liberal wages stop and waste begin? Where does proper shortening of the working day merge into a wasteful disuse of human power and mechanical equipment? Where does catering to legitimate demands run off into wasteful regard of the unreasonable requirements of the customer? Where does service run over the boundary into dis-service? How much truth is there in the claims of the expert accountant, his nose buried in a mass of figures and his eyes probably blind to the human equation, that this, that or the other practice constitutes waste? Where may we draw the line between the waste which can profitably be eliminated, and the ten-cent waste that it would cost a dollar to prevent? These are the questions which are brought forcibly before modern industry in connection with the ever-increasing clamor against waste. The present article is the first of a series of three in which Mr. Hudson indicates the direction in which the answers may be sought. Of his qualifications to write on this subject we need say no more than is said by the third line at the head of this page.—THE EDITOR.



Figs. 1 and 2, two views of the bevel-gear tester. Fig. 3, apparatus for checking up the elements of spur gearing

Two of the elaborate measuring instruments which insure that gear wheels shall be interchangeable

Gear-Testing Machines

ANYONE who has had to do with the production of accurate gearing for high-class machinery such as aero engines, machine tools and instruments of precision, especially when such gearing has to be strictly interchangeable, is well aware of the difficulties attending such production, despite the great advance made in automatic gear-cutting machines of recent years. The best results cannot be obtained from these machines unless it is possible to check the production for accuracy in every respect. The usual tool-room methods are slow and liable to inaccuracy, depending as they do to a great extent upon the skill and care of the individual applying them.

From time to time instruments have been devised to overcome this and other difficulties, but their use was generally limited to checking the distance apart of the wheels and verifying their true running.

We are able to illustrate some new instruments recently introduced by the Societe Anonyme Adolphe Saurer of Arbon, Switzerland, by means of which it is possible to check the pitch and profile of the teeth at the same time recording the results directly on paper.

In Fig. 3 is shown a machine for checking the truth, profile, pitch and play in teeth of spur wheels. The two gears under test are shown in mesh mounted on two axles by means of suitable sleeves. When the extreme left-hand lever shown under the bed is released the distance between the axles can be regulated by the hand wheel at the right-hand side to the exact center distance.

On turning the two gears under test a pointer on the dial on the left of the machine bed will show if the wheels are out of truth, and if so, how much, the divisions on the scale being 1/100 mm. The play in the teeth is also shown by the formula $\frac{N \times 2 \times \tan L}{100}$, N being the number of divisions on the scale traveled by the pointer and L the angle of pressure.

The two disks on the axles immediately above the bed are friction disks, the diameter of which is the same as that of the pitch circle of the wheels to be tested.

They are so arranged that when one gear is caused to rotate the other, the disks will have an irregular rotary movement in the event of a faulty tooth coming into engagement, and these variations, which would be a lead or lag behind the motion of the gear, are recorded on a special dial for the purpose shown above the left-hand gear. These variations are, of course, multiplied, and are recorded on a circular disk of paper in the form of an irregular line, which would approach a true circle if the gears were true.

In Figs. 1 and 2 is shown a bevel-gear tester. It will be seen that the bed of the machine is a heavy circular casting upon which the two heads slide and can be locked in any position, according to the angle of the bevels. There is a vernier scale on the bed to test this. When it is required to test for bodily distortion, a common enough defect due to faulty hardening, a large milled nut at the back of the wheel is loosened and the wheel pressed forward by a spring to insure its teeth going right home into the bevel, which may be a standard one for test purposes or merely the mating one for the wheel under test. The bevel pinion is then rotated by means of the hand wheel just visible on the extreme right, and if the wheel is distorted its spindle will oscillate endwise. This oscillation will then be transmitted to and magnified by the pointer on the dial on the left-hand side, in the same way and to the same scale as that of the spur-gear tester.

For testing evenness of pitch and regularity of tooth form the gears are first set in correct mesh by means of end gages which determine the position of the spindles in the heads. A friction disk will be observed at the right of the machine. This is driven by the spindle through friction gearing inside the casing.

A similar shaft at the left-hand end of the machine is hollow and carries the recording dial as shown.

Up the center of this hollow shaft is a pin, on the top of which is a circular table upon which the recording chart is placed.

If either of the main gear spindles is rotated one of the friction disks will be driven idly round and the indicating instrument at the other end of the machine will be rotated round the chart which is fixed.

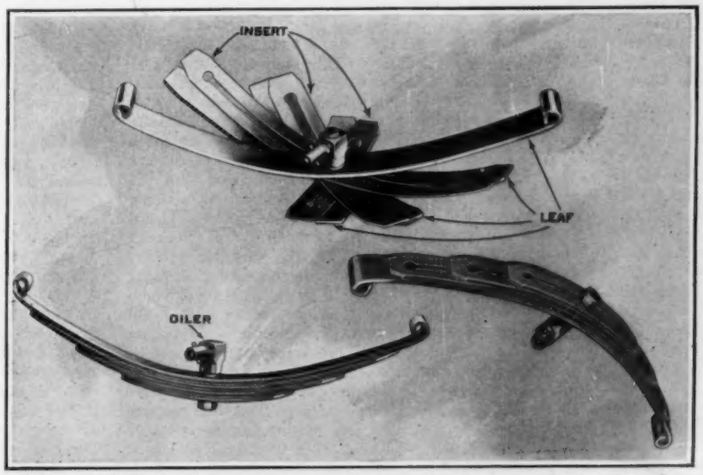
Thus the pointer would remain stationary relative to its scale, and a circle would be drawn by the pen on the chart, but it will be observed that there is a rod at the rear which bears on both these disks; it serves, in fact, to couple them together. Again, these disks are of various diameters, so proportioned, however, that, in conjunction with the diameters of the driving disks referred to, the friction disk underneath the instrument is driven at precisely the same speed ratio as the instrument itself if the speed ratio of the bevels under test is constant.

A finger in connection with the latter disk comes into contact with a stop on the instrument and is so adjusted that the pointer is moved to the center of its scale, the pen also taking up its mean position on the chart meanwhile.

If there should be any irregularity of the speed ratio of the gears under test the finger will move the pointer slightly, thereby causing the pen to move radially over the chart. Thus in place of a practically true circular line on the chart as would be drawn with correct gears, a wavy, jumpy one will result, the deviations magnifying the inaccuracies 100 times.

In Fig. 2 an arrangement for testing the straightness and angle of the teeth is shown. The ball-ended column is fitted into a conical seat in the bed, but permanently located, so that the center of the ball exactly coincides with the intersection of the axes of any bevels under test. The hardened steel gage shown has a conical cup near one end. This fits over the ball. Its use is therefore quite obvious, when it is borne in mind that when fitted over the ball a true straight edge along the business side of the gage is formed.

The trend of present-day machine-shop practice is toward automatic testing, in a single operation and by special machines, of an entire finished piece. That it is possible to apply this procedure to gear wheels, with their many possible minute deviations from standard, however, is a good deal of a revelation.



The steel inserts that go between the leaves of the spring and make lubrication an easy task forever after.

Keeping Springs Young

THE average car rides more roughly than it ought to, and its springs wear out sooner than they ought to, simply because adequate spring lubrication is not a job which the average owner can do for himself with sufficient ease to induce him to keep it done. A putty-knife is not the proper tool to separate the leaves with, yet it is about the best tool for the purpose which Mr. Average Owner has at hand. But if the spring is assembled with the steel inserts illustrated herewith, lubrication is so absurdly easy that there is no excuse for neglecting it. A heavy oil is put in through the oiler at the center, and is carried by this to the channels in all the inserts, through which it reaches all the bearing surfaces of the leaves. In longer life and better service, the well-lubricated spring will more than repay the owner for the initial trouble of putting in these inserts.

America's Busiest Radio Station

The Receiving Center at Riverhead, Long Island, and the Principles on Which It Works

Left: This attractive shingled building houses the receiving apparatus at the Riverhead station. *Center:* A portion of the 9-mile antenna on the 30-foot poles. *Right:* Some of the apparatus employed for the simultaneous reception from different transmitting stations in Europe

Three glimpses of our busiest radio station

ALTHOUGH Radio Central, the huge transmitting station near Port Jefferson, Long Island, some seventy miles east of New York, is our largest radio station, the fact remains that Riverhead, but a few miles away, is the most versatile and also the busiest. Why? Simply because it is the receiving station, and can listen to more stations than Radio Central can talk to at present.

Radio Central can talk to Wales, France, Germany or Norway with ease, but Riverhead can listen simultaneously to Wales, France, Germany, Norway and other powerful stations that may later be established. And at the same time it can close its ears to the powerful impulses sent out only a few miles away by the giant Radio Central, as well as the New Brunswick, Marion and Tuckerton stations, not forgetting the 90 per cent of the atmospheric disturbances coming from every point of the compass which it throws out.

It is more dramatic, more impressive, no doubt, to hurl radio messages across three or four thousand miles of land or water, than to pick them up at the other end. That is why almost every person interested in radio knows a good deal about Radio Central and its 2000-kilowatt alternators, and very little about Riverhead, which picks up and revives the once powerful electromagnetic waves after their long leap across the Atlantic.

From an engineering standpoint, however, what has been accomplished at Riverhead in the receiving line is as remarkable as what has been done at Radio Central. Riverhead does its work quietly and without ostentation; Radio Central's tall towers and magnitudinous currents advertise it to the world.

A few years ago in this country, and at the present time in all other countries, every sending station had its complement in a receiving station, located about fifty miles from it, and connected with it by telegraph lines. The one station talked; the other listened. Now Radio Central, New Brunswick, Marion and Tuckerton all talk; and Riverhead competently handles simultaneously the incoming traffic of all the European centers with which they are connected. The explanation of Riverhead's efficiency is the long-wave directional antenna.

The station is not a network of antennae such as the mind would picture. It has simply one antenna consisting of two copper wires nine miles long, strung on ordinary telegraph poles. One station building contains the receiving apparatus which separates the conglomeration of signals received from Norway, England, France, Italy and Germany, and transfers them directly and automatically over trunk line wires into the Broad Street traffic office in New York City—around the corner from Wall Street— where all incoming and outgoing messages are handled. The system of concentration, achieved after much experimentation, makes it possible to add new receiving circuits for communication with any new station in Europe, simply by installing a new set of receiving apparatus.

The antenna is of a new type which gives uni-directional reception, so oriented as to receive signals from the over-ocean transmitter, and to ignore signals from all other directions, including the powerful home transmitter nearby. From this nine-mile wire are fed a number of separate receiving circuits of different wave-lengths, without the slightest mutual interference or weakening of the signals.

Important as it is from the point of view of centralization to be able to receive an indefinite number of signals from the same antenna, the greatest importance in the use of this new receiving system is its remarkable properties of suppressing atmospheric disturbances, or the so-called "static" which hitherto has been the bane of radio communication. The attainment of these results is not an accident; it is the reward of development work covering a number of years.

The "wave antenna" as now used in Riverhead is the practical answer to the receiving problem of today. It is the milestone in the development of the principle of directive reception. This is a principle which has almost unlimited possibilities. This practical form of receiving system, which was first described by E. F. W. Alexanderson in 1919, was used by the United States Navy during the war and become known as the barrage receiver. It consisted of two antennæ one-quarter wave-length long, balanced against each other. The wave antenna of today does not require any balancing. The receiver of the future will probably consist of an antenna several wave-lengths long or several wave antennæ balanced against each other.

The controlling idea in this development is a mental picture which we now have of the nature of the disturbance which we wish to suppress. We call it static because it was assumed, in the past, that it was of the nature of static electricity. The hypothesis which is the basis of our modern work is, however, different.

We imagine the ether as a disturbed ocean with the waves of every length rolling in from all directions. These waves are of the same nature as the signal waves. Those disturbing waves which are of different wave-length from our signals can be shut out by the same means as we use for shutting out other signals: that is, by tuning. But the disturbing waves which have the same wave-lengths as our signal and in all respects of the same nature pass through our tuning system like the signal. We must therefore find some other basis for discrimination than wave-length.

If we can construct a receiver which is sensitive only to waves coming from one direction then we can shut out waves from all other directions, even if they have the same wave-length. This idea started us on the work of directive reception. Theoretically there is no limit to the improvement attainable in this direction. We could build a receiving antenna focused on a single transmitting station in Europe; but the antenna might be a system of wire covering the State of New York.

It is an attractive subject for theoretical analysis, and it can be shown mathematically how extensive antenna systems can be made with unlimited directivity. The well-known "loop vertical directive antenna" has a deaf ear in one direction, but receives signals and disturbances from three directions. The wave antenna turns its deaf ear to three directions and receives only from the fourth direction. For those who wish to understand the characteristics of our modern receiving system, in order to make use of it, a popular explanation may be of some guidance.

Imagine the antenna to be a long, narrow lake, and the wind is the signal, and a cork, floating on the waves that beat against the shore, the detector. If the observer stands at one end of the lake he will observe waves beating against his shore only when the wind blows lengthwise of the lake, from the opposite shore. When, on the other hand, the wind blows from his side of the lake the beating waves appear in the opposite end, while his shore is calm.

This, at least, would be the case if the lake had smooth sand beaches on which the waves would spend their force. But, if it has steep, rocky shores, the waves will be reflected back and forth so that the whole lake will be rough. The waves, which indicate the signal wind, would thus appear at both ends of the lake, regardless of the direction of the wind.

The wave antenna is therefore made with ends corresponding to the sandy beach. It terminates in a resistance which is carefully adjusted so that all wave energy is absorbed and none is lost.

The practical advantages of the use of the wave antenna are: The elimination of something like 90 per cent of the atmospheric disturbances and the possibility of concentrating all reception in one station. The developments, according to some radio men, show now that a practical solution has been found for the atmospheric disturbances in trans-oceanic communication. The same solution has been applied to ship-to-shore communication, with the result that ocean liners are in touch with the Cape Cod station as soon as they leave the English Channel!

The stations from which the signals to Riverhead are sent almost continuously are Bordeaux, France, sending on 23,000 meters; Carnarvon, Wales, 14,100 meters; Stavanger, Norway, 12,000 meters; Nauen and Eilveese, Germany, 12,600 and 14,700 meters, respectively.

One of Nature's Own Pipe-Lines

IN the city of Bath, Maine, while workmen were busy recently, quarrying out stone from a stone-crusher, they uncovered, at a depth of about 20 feet from the surface, a water conduit about 3 feet wide and 2 feet high. This conduit is in the solid ledge, has been opened up for a distance of 200 feet and is of a uniform diameter the entire way.

The four sides are corrugated deeply, showing that at some time water ran through it at great pressure. Many people have visited the interesting spot, as very few have ever before seen one of nature's pipe-lines exposed.

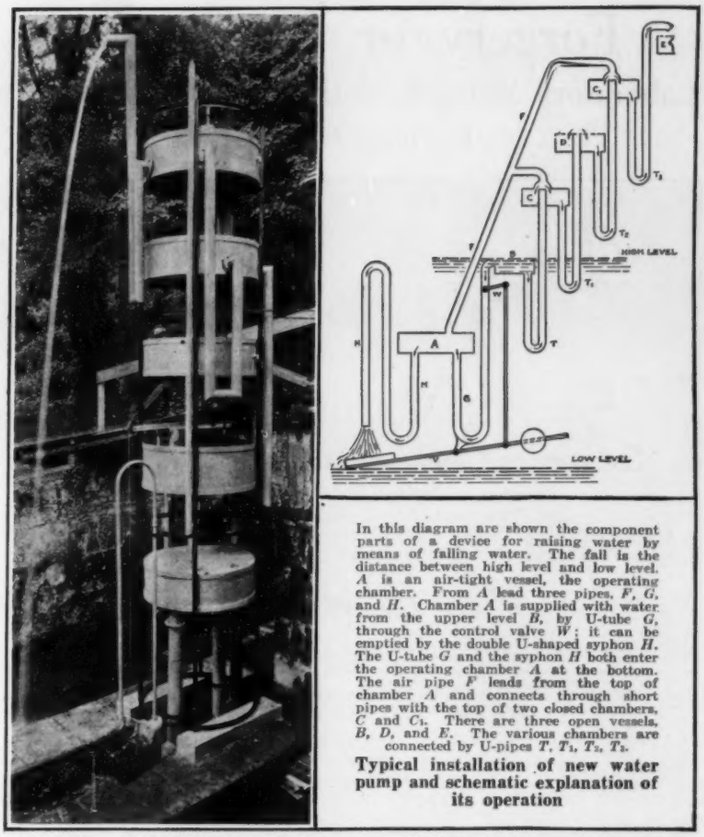
A Novel Method of Pumping Water

WE show in the accompanying photograph and diagram a decidedly novel method of raising water from one level to another, the motive power being furnished by falling water. The device was developed by Mr. T. G. Allen of London, and the experimental plant illustrated is operating successfully. To start the pump, for such it is, the two closed containers, *C* and *C1*, are filled with water. The valve *W* is then opened, so as to permit water to flow from the open container *B*, placed at the higher level of a stream, into the closed operating chamber *A*. The siphon *H* is thus filled with water, and as the water rises within the operating chamber *A*, the air in the chamber is compressed, as is also the air within the pipe *F* which communicates with the two smaller closed chambers *C* and *C1*. As the result of this pressure, the water in the closed chamber *C* is forced through the U-pipe *T1* into the open vessel *D* at a higher level, and similarly water in closed container *C1* is by this air pressure forced through the U-pipe *T3*, into the open vessel *E* at the top of the system. From *E* the water can be drawn for use.

The discharge from the siphon pipe *H*, acting upon the lever *V*, closes the valve *W* at the top of the U-pipe *G*, and the action of the siphon *H* now causes a partial vacuum in the large container *A*, and also in the pipe *F* and the closed containers. Water is sucked from the headrace *B* into the container *C* through the U-pipe *T*, and also from the open container *D* into the closed chamber *C1*, by way of the U-pipe *T2*. The U-pipe *T1* is slightly longer than *T*, to make it impossible for air to be drawn through *T1*; and the same for *T2* and *T3*.

Now, as soon as equilibrium has been reached, the water is no longer flowing from siphon *H*, the valve *W* is again automatically opened by the weighted lever, and water is allowed to flow once more from *B* into the operating chamber *A*, compressing the air and bringing about another cycle. From this it will be seen that this form of pump will run automatically and continuously as long as there is a supply of water to be drawn upon and passed from high level to low.

In the installation here shown the various tanks are placed vertically one above another, about the same vertical axis, but it will be understood that this was merely a matter of convenience in the experimental plant. The number of lifts can, of course, be made as many as desired, provided the capacity of the operating chamber *A* is equal to the combined capacities of all the closed containers above it. Also it will be understood that the height to which the water can be lifted cannot exceed the difference between the water in the headrace at *B*, and in the operating chamber *A*. At the demonstration which we saw in this city, the plant worked with great smoothness, and with a surprising freedom from concussion. The hydraulic efficiency is estimated at 80 to 85 per cent.



In this diagram are shown the component parts of a device for raising water by means of falling water. The fall is the distance between high level and low level. *A* is an air-tight vessel, the operating chamber. From *A* lead three pipes, *F*, *G*, and *H*. Chamber *A* is supplied with water from the upper level *B*, by U-tube *G*, through the control valve *W*; it can be emptied by the double U-shaped syphon *H*. The U-tube *G* and the syphon *H* both enter the operating chamber *A* at the bottom. The air pipe *F* leads from the top of chamber *A* and connects through short pipes with the top of two closed chambers, *C* and C_1. There are three open vessels, *B*, *D*, and *E*. The various chambers are connected by U-pipes *T*, T_1, T_2, T_3.

Typical installation of new water pump and schematic explanation of its operation

The photograph and diagram show a new method of raising water by means of falling water

Recent Developments in British Pelton Wheel Design

COMPARED with America and some of the European countries little has been done in England toward the development of the Francis and other reaction turbines. In fact, it is only quite recently that the Francis turbine has been built in England on modern lines, but there are now several firms of standing engaged in Pelton wheel construction. These firms have developed their designs on more or less similar lines to American practice. Some wheels of 8000 H.P. have been built recently for Tasmania. The principal improvements effected in this type of wheel are in connection with governing, the needle-cum-deflector system operated by oil pressure having been brought to a high state of efficiency. This system is, of course, well known to American engineers and needs no description here. Improvements have also been made in runner construction, principally as regards the strength of the wheel and buckets to withstand the enormous centrifugal force set up at high speed on powerful wheels. One firm, however, Gilkes, of Kendal, who have been in the turbine business for a number of years, have recently introduced an entirely new design of runner. Its general construction will be seen in the accompanying illustration.

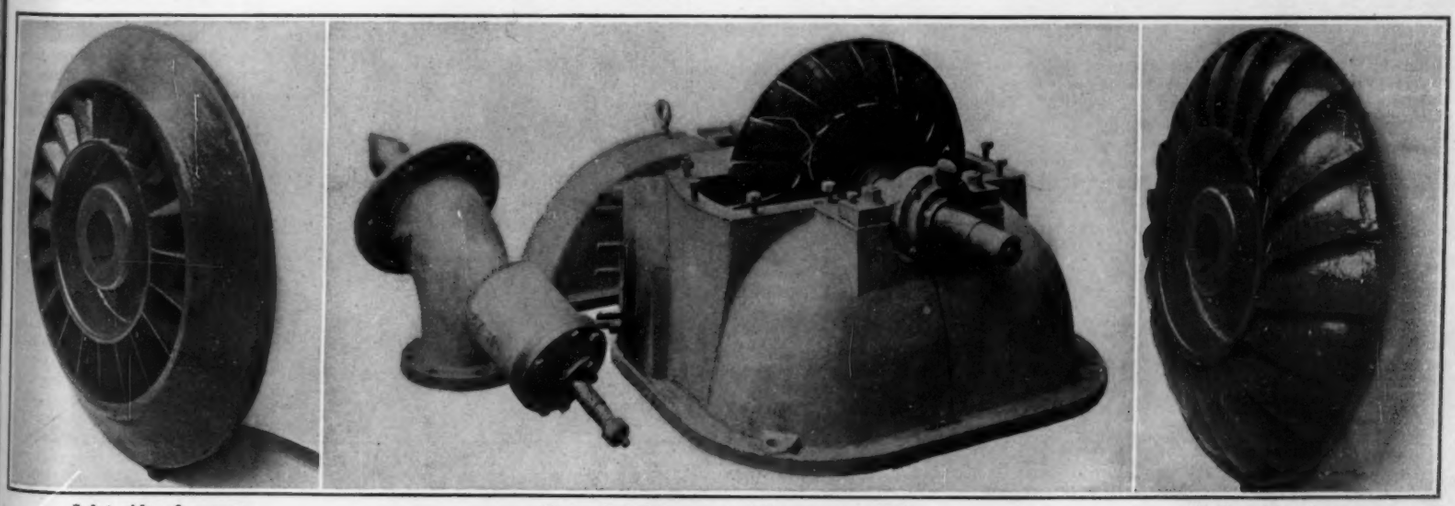
It will be seen from the illustration that the runner is cast in one piece with its vanes, central disks, and outer rim. It is claimed that this construction is both stronger and hydraulically more accurate than a built-up wheel. It will also be seen that the water is guided on both sides and must follow a definite direction. Another point of note is that the windage is reduced. It is therefore possible with this design, which is patented, to use a much larger jet for a given size of wheel; in fact, a jet as large as one-fifth the main runner diameter can be used. This permits the use of a smaller runner for given conditions which will give a higher speed with its attendant advantages. This design of wheel has been produced to meet conditions where a Pelton of the same power would run too slowly, and where for various reasons it might be undesirable to use a high-speed Francis or other reaction turbine. This new impulse wheel, which has only recently been introduced, is known as the "Turgo." The governing is effected by a modification of the deflector system, a shaft governor being at present employed for the purpose. Ball bearings are used both for axial and thrust loads, the casing being of cast iron. These particulars refer to an experimental wheel designed to develop 180 b.h.p. on a fall of 240 feet and a speed of 600 r.p.m. The mean diameter of the runner is 21 inches. If this type is built in larger sizes modification of the constructional details would be necessary, while it is doubtful if a positively operated governor as at present employed would suffice for large sizes. Altogether, the wheel is of interesting design, and from some tests made by the Professor of Engineering at Manchester University, the efficiency appears to compare favorably with other turbines of similar power. The tests referred to were carried out on scientific lines with a rope brake for measuring the power and a sharp-edged rectangular weir 2.995 feet long without end contractions, the Francis formula was used for calculating discharge. An abstract from the test results is given below.

Tests with Brake Load

Expt.	*Revs.*	*Head*	*b.h.p.*	*q.c.f.s.*	*w.h.p.*	*Efficiency*
1	629	212.4	7.06	.723	17.46	.405
3	629	208.1	27.95	1.668	39.52	.709
5	629	206.9	36.22	2.053	48.25	.751
7	623	211.6	64.81	3.350	80.50	.805

Tests with Dynamo Load

Expt.	*Revs.*	*Head*	*k.w.*	*b.h.p.*	*q.c.f.s.*	*h.h.p.*	*Effic'y*
9	640	226.6	25.30	39.22	2.021	39.22	.754
11	638	225.0	37.92	57.30	2.800	73.05	.784
13	640	218.3	71.62	106.3	5.14	127.6	.834
15	632	212.2	82.51	122.5	6.29	151.8	.806



Inlet side of runner — Turgo impulse runner with cover removed — Outlet side of runner

Forgery or Genuine?

Some New Laboratory Methods of the French Handwriting Experts

By Francis P. Mann

WITHIN the last twenty years a remarkable progress has been made in the question of expert examination of handwriting. In France, an important center for these researches is the Technical Laboratory at Lyons, attached to the Police Department, and under the efficient direction of Dr. Edmond Locard, much excellent work is being carried out at the present time. From various documents which he has kindly furnished us, we are able to give a brief extract whose object is rather to show the general character and scope of the modern researches of this kind than to enter into details, which are often of a more or less complex nature. In our various sections we will refer to different classes of operations which are carried out.

By measuring the height of each gramma (*i. e.*, each letter or stroke), it is found that the mean height remains constant for a given gramma as compared with the mean heights of the other letters, and this irrespectively of the size of the writing. If the person has the habit of making his *f*'s very small and his *r*'s very large, this will always hold good, and if the grammas are disposed in the order of increasing height, this order will not be modified in spite of large or small handwriting. It is an easy matter to form a curve having as abscissae the grammas in the order of increasing height and as ordinates the heights. To study an authentic document and a supposed forgery, it is only required to juxtapose the curve for each, and if by the same person, they will be superposed or at least parallel, but if not, they will diverge. In actual practice this method affords excellent results, and it is readily observed in many cases that the relative heights of the various small letters are not at all the same in the authentic and in the suspected documents.

The term "gladiolage" is used in graphometry to denote a regular decrease in the heights of letters. If we measure each of the grammas of a word which are in the class of small height (a, c, m, etc.) we find that in certain writing these heights tend to decrease, according to a more or less definite rule, from the beginning to the end of a word, while in other cases the decrease will be interrupted by a sudden upward shoot near the antepenultimate, and in still others there is an approximate equality between all the grammas of a word. To determine the rule of increase or decrease, we may measure the grammas of a chosen type of word, for instance the pentagrams or octograms (words with five or eight grammas), or again, measure the heights in all the words irrespectively of the length, dividing the grammas into similar sections. Curves are made with the sections as abscissae and the mean heights as ordinates.

Turning to the practical applications of this method, it is observed that in certain instances the authentic texts show gladiolage to a considerable extent, though this is irregular, while the suspected text does not show gladiolage but has the minimum height in the middle section of the words. By using a selected method for the construction of curves based on this principle, we may produce, for instance, the curve for the authentic writing alongside the curve for the suspected writing, and there is usually seen a considerable divergence, which is, of course, instructive.

The distance between the successive grammas of a word may be, according to Dr. Locard, progressive, equal, or degressive. To find the rule for increase (positive or negative) of spacing of grammas in a given piece of writing, we measure in tenths of a millimeter the spacing of the axes (or bases) of each gramma—and not of each letter—in a given type of word. This type should have some length, being at least on the order of the hexagrams. The same operation is carried out for the authentic and the suspected writing, the figures obtained for the suspected text being multiplied by the observed ratio between the mean heights of the small letters in the suspected and the authentic text, in such manner as to render the figures comparable, irrespectively of the different size of the texts. Curves are then drawn having as abscissae the ranges or sections (of like nature) and for ordinates the spacing.

In practical tests we may consider, for instance, the case of one supposed forgery in which the writing was considerably higher than in the authentic document. It would be logical to suppose that this difference in height meant a like difference in the other dimensions, but by measuring the spacing of the letters it is found that the mean value of this spacing is less in the supposed forged document. By suitable calculations we obtain as an indicative figure the value 46.68 compared with 31.14 (in the suspected piece). It is therefore concluded that the two pieces of writing are of a radically different type.

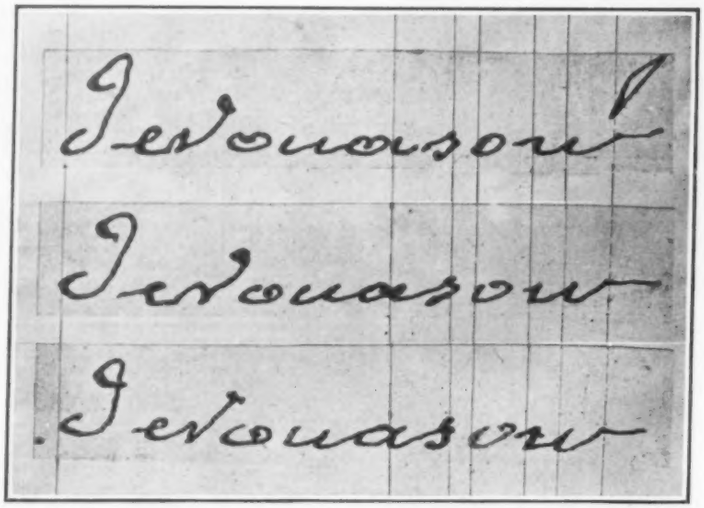
The relation between height and width for a given letter requires the measurement of the width of the grammas, and it is found that this operation is difficult to carry out. It may, however, be done with exactness by taking only the closed grammas such as *o*, the main body of *a*, or the top of the *g*.

When we measure by means of a transparent goniometer the angles formed, for each type of gramma, by the axes of the same with the base line, it is observed that these angular values, which are substantially constant for a given gramma, will vary considerably from one gramma to another, and if the original writer modifies by reason of change of speed or other purpose the mean inclination of his handwriting, the proportions between the angular values of the different grammas will remain the same. On the contrary, in the best imitations, the forger may indeed be able in extreme—but rare—cases to reproduce about the same mean obliquity as in the original, he will never be able to preserve the proportions between the various angular values. On the contrary, he will substitute those of his individual graphic system; hence the great utility of this class of measurements.

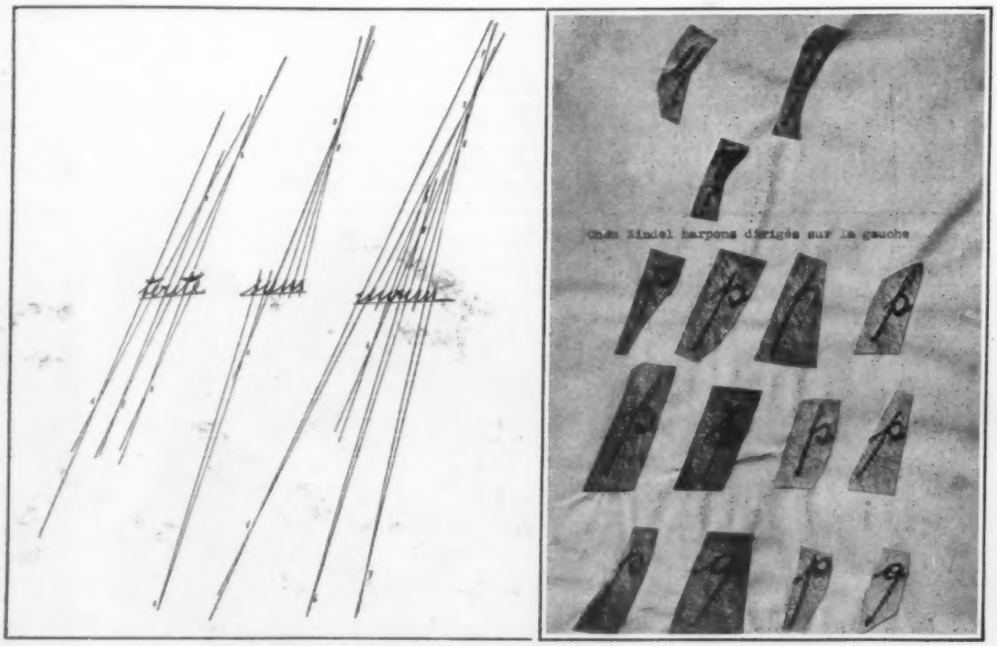
It has also been observed that the angular value (save in case of school penmanship and the like) undergoes considerable changes in the same word, and the axes of the grammas are far from being parallel. When prolonged, they will intersect at greater or less distances. The height of the intersections is quite variable and is very characteristic, being almost impossible to imitate by the forger who is of course unaware of our methods. By running a line through each gramma and observing the intersection with the next gramma, a figure is obtained which is of a most characteristic nature.

This is one of the most valuable methods for the examination of handwriting, as it is very easy to observe the difference in parallelism in any two cases. In two specimens compared, the figures found were 366.0 and 807.31. In the original, the in-

(*Cont. on page 446*)

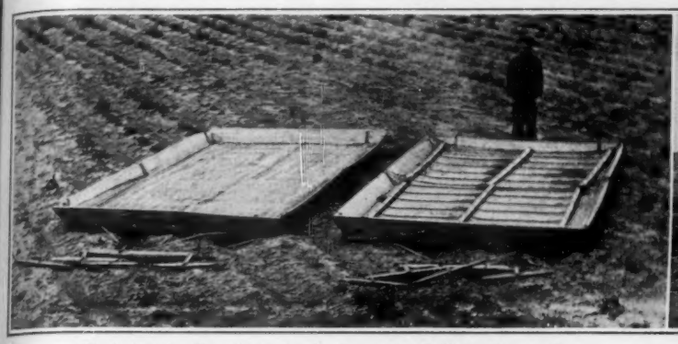


Three forgeries, all traced from the one model. They match up too closely to make their genuineness possible of belief



Left: The manner in which the slopes of the letters in a suspected document are checked up by the expert. *Right:* The three upper examples are taken from a suspected sample, the twelve letters below from a genuine holograph by the same subject. The forgery is revealed when magnification shows the hooks at the bottoms of the long letters to turn to the right instead of the left

Typical tests applied by the handwriting expert to determine the genuineness or falsity of signatures, etc.



Sleds for hauling beet shocks from the field to the stacks

Unloading the beet shocks with slings and stackers

Harvesting Sugar-Beet Seed in Sleds

APPROXIMATELY 16,000,000 pounds of sugar-beet seed are put into the ground annually in the United States, half of which are imported from other countries. Growing seed for sugar-beet culture is an industry of itself, being developed rapidly in the irrigated regions of Colorado, Montana, Utah, and Idaho. With the expansion of seed production, and with labor shortage as a retarding factor, wagons are being displaced by specially designed sleds in hauling beet shocks from the field for stacking. The labor replacements are curtailed by half, and likewise wastage of the seed is reduced to a minimum.

Home-made in design, the sleds are 10 by 18 feet in size, built with sloping sides one foot high. Dissimilar to the sleds which glide over snow-capped surfaces, these beet-seed conveyances operate most advantageously in the absence of runners. A double floor is made by nailing matched lumber to the upper and lower sides of five cross-pieces of 2 by 6-inch scantling. The irksome job, as heretofore practiced, of dragging canvases from shock to shock to catch seed from the necessary vaulting of the crop is obviated.

The seed is unloaded from the sleds to the huge stacks by means of slings, and stacked as illustrated in one of the photographs reproduced. Two nets are placed on each sled, and an equal number of operations will empty a 2500-pound load in eight minutes. Four men construct the stack, four teams of three horses each haul the seed to the concentration point, and two crews of two men each pitch the shocks on the sleds. A couple of operators negotiate the derrick, while one man drives the team. A crew of 15 laborers, counting the drivers, and 14 horses will stack 10 acres a day. An ordinary grain separator is used in thrashing the sugar-beet seed, a crew of 10 men yielding 30,000 pounds of seed a day. So much for the labor and machinery entailed in obtaining seed that will ultimately replenish the nation's sugar bowl.

Turn-plow for filling back the dirt into a drainage ditch after the tile is laid

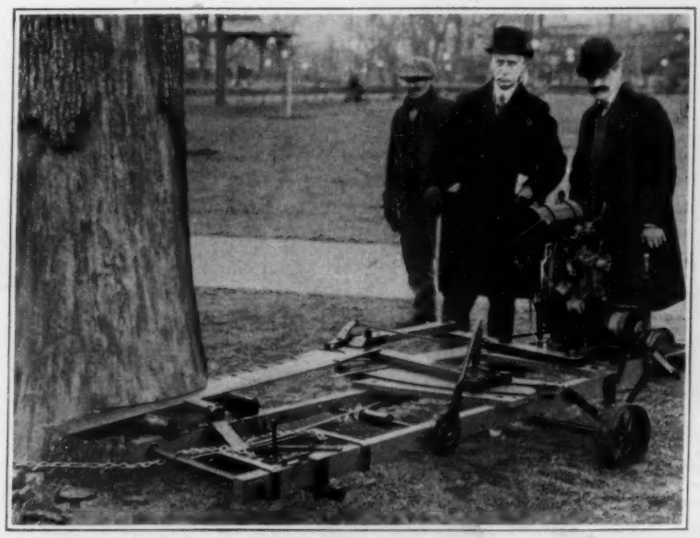
Iron Ore in Europe

IN *Nature* for June 17, 1922, Professor J. W. Gregory, F. R. S., discusses the question of iron ore in Europe.

The outstanding feature of the present position is the overwhelming predominance of France in Europe as regards supplies of iron ore. In this respect France among the nations of the world stands second only to the United States. "France has the largest reserves. She stands so clearly above the other countries of Europe that there is no question of her holding first place." The French known, probable, and possible iron ores are estimated at a total of 4,369,600,600 metric tons, a total which amounts to 35.2 per cent of the iron ore reserves of Europe; the British Isles take the second place with 18.2 per cent, Sweden is third with 12.5 per cent, the German Republic fourth with 11.1 per cent, and Spain is fifth with 5 per cent. Russia, with a total of 8.3 per cent, is subdivided into the central, southern and Ural regions.

The large volume of French ores is due to the sedimentary ores in the Jurassic field of Lorraine. The sedimentary ores of Europe range from the pre-Cambrian beds at Krivoi Rog in southern Russia to the Pliocene ores of Kerch in the Crimea, and representative beds occur in most of the geological periods; but the most important supply comes from the Jurassic, which contains 46 per cent of the European sedimentary ores. These ores contribute 70 per cent of the total; the replacement ores amount to 12 per cent; the contact deposits and magnetites, of which the genesis is doubtful, amount to 16 per cent of Europe's total.

The reserves of iron ore in the world are estimated as sufficient to maintain the production of 1913 for 1000 years; but if the output of iron increases at the pre-war rate of 5 per cent per annum, the supply would be exhausted in about 130 years. A fall in the rate of increase appears inevitable, however, and consequently the ore reserves will have a longer duration.



The machine that multiplies the lumberjack's speed by eighteen

Filling Back the Drainage Ditch

FARM drainage is at best an expensive proposition. Ditching costs money; tile costs money and placing it costs more; and filling back the ditch is perhaps the meanest and most expensive angle of the whole job. A recent development for putting speed into this operation and robbing it of some of its costliness involves the use of a turn-plow coupled to an evener 12 or 14 feet in length. Two horses are hitched to the plow, one on either side of the ditch. Then with one man to drive and another to navigate the plow, the soil is neatly and expeditiously returned to its place in the ditch. The photograph shows the process in use on a southern farm, with labor of none too high a grade; and if it will work there it should work everywhere.

Sources of Elementary Radio Information

MANY persons interested in the operation of radio stations are not directly concerned with the operation of either government or regular commercial stations. Some are interested in maintaining a private system of radio communication over comparatively short distances, while many others are interested in radio because it offers a very fascinating experimental field.

Different kinds of useful information, such as weather reports, market reports, time signals, and music, as well as other entertainment, are transmitted daily by radio and received by thousands of persons in all parts of the United States.

The recent developments in radio communication have been so rapid that a great deal of important information has not been collected in books, but must be sought in periodicals and other sources. A number of important books have appeared very recently and are not yet generally known. The Bureau of Standards is constantly receiving requests for radio information, and since the same information is called for by many of the inquiries received, and in order to facilitate answering such inquiries, Circular No. 122, entitled "Sources of Elementary Radio Information," has been prepared and may be obtained from the Government Printing Office, Washington, D. C., at 5 cents per copy.

This circular gives information concerning radio periodicals, government radio publications issued by various bureaus, radio books from numerous publishers, radio laws and regulations, call letters, and safety precautions to be observed at radio stations, and it answers a few of the most usual elementary questions which are asked by the novice.

Cutting Trees by Machine

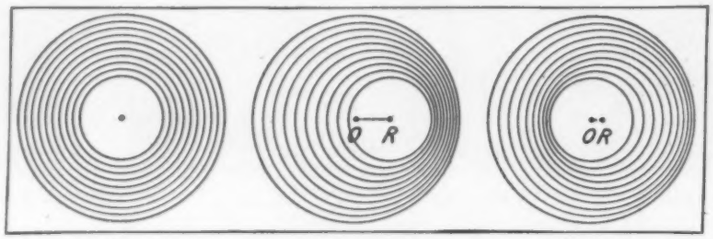
SOMETHING new in lumbering is promised from the machine which we illustrate herewith for felling trees. At a recent demonstration in Central Park, New York, this low-hung horizontal affair walked through the trunk of a big tree at a speed of eighteen times that attained by hand sawyers. The machine shows very good design in the arrangements for enabling the saw to advance with its work, and maintain its position and its pressure at the bottom of the cut.

Fog Signaling by Polarized Sound

A Simple Arrangement for Determining the Exact Direction from Which a Signal Comes

By Anders Bull

IN ordinary fog signaling by means of whistles, horns, or bells, the location of the sender is usually estimated by instinctively comparing the intensity of the sensations produced in either ear by the signals. How extremely unreliable such observations are is a matter of common experience. Our sense of intensity is crude while the difficulties to be judged are very slight so that secondary efforts may easily throw the balance to the wrong side. Such effects are mostly due to reflection, taking place not only at the surface of nearby objects, but wherever there is a change in the density of the medium through which the sound-waves are passing, as at either side of a fog bank. Another disturbing factor is wind which causes an apparent strengthening of signals in the direction of its own movement.



A: At rest B: Uniform motion C: Oscillating

Fig. 1: How the pitch of a sound signal is affected by motion of the source

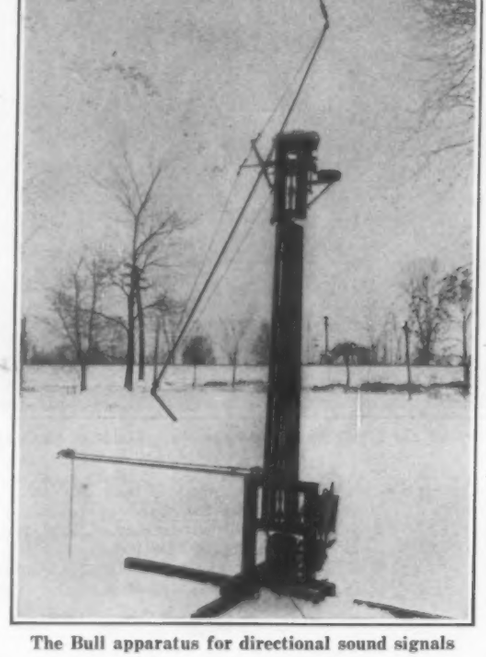
By means of a device developed by the writer, aerial fog signals may now be produced which are not subject to the defects above referred to. Its salient feature is that it permits the direction of the signals to be determined from their *pitch*, a quality entirely apart from intensity and governed only by the rapidity of the sound-vibrations. Pitch is as important to our hearing as is the direction of light to our vision; just as by the direction of light-waves we are able to discern the shape of things, so by the pitch of sound-waves do we make ourselves understood, speech being mainly a conglomerate of a great variety of simultaneous pitches. This has made our sense of pitch a highly developed faculty so that variations of only a fraction of one per cent are distinctly perceived. The advantage gained by making pitch, instead of intensity, the governing factor in the observations is hence obvious.

The writer's device may be worked with most of the sound-sources in use at present, without any shortening of their range. No receiving outfit is required, a very important feature, since receiving instruments need expert help for their handling and involve expenses beyond the reach of smaller craft; while signals that may be received by the unaided ear are of service to any vessel and place the helmsman in direct touch with the signaling party, thereby insuring prompt action with less chance of mistakes and confusion.

The signals are produced in groups of four or eight, the signals of a group following each other at equal time intervals and being all of the same duration. To an observer listening to such a group the individual signals will, as a rule, be partly of rising and partly of falling pitch. By counting the number of either kind he will be able to determine in what direction of the compass the signaling party is located. This is accomplished by putting the source of the signals through a series of rapid movements, the effect of which upon the sound-waves will presently be explained.

The waves emitted by a source of sound, like a whistle, will spread out over the surface of the earth in much the same manner as do ripples over the surface of a pond at the plunge of a pebble, each wave moving out from the point where it was generated, with a velocity of about 1100 feet per second, as a steadily expanding circle having this point for its center. As long as the whistle remains in one place all the waves produced by the blast will have the same center and form a belt of uniform width. (Fig. 1, A.)

With the sound source in motion results are different. If, for instance, the whistle is moved at uniform speed toward east, from *O* to *R* (Fig. 1, B), while a blast is being produced, then *O* will be the center of the first (outermost) wave, and *R* that of the last. The wave belt is thus no longer of uniform width but has become narrower in front of the movement and wider in rear, the movement having crowded the waves toward east. Their velocity remaining the same, 1100 feet per second, the waves headed east must follow closer upon one another and give rise to vibrations of greater rapidity, so that east of the whistle the blast will have a higher pitch than north or south of it, while to the west, where the spacing of the waves has been increased, the blast is of lower pitch. Generally speaking, the amount by which the observed pitch is higher or lower than the wave pitch of the whistle will, at any point, be in proportion to the rate at which the whistle is approaching or receding. This phenomenon, known as the Doppler Effect, is easily observed by anyone standing close to a railroad track while a locomotive blowing its whistle is passing when there is a sudden fall in the pitch of the blast at the instant of passage.



The Bull apparatus for directional sound signals

It will now be assumed that the motion is oscillatory, the whistle being moved toward east, from *O* to *R* (Fig. 1, C), at decreasing speed during the first half of the blast, and toward west, back to *O*, at increasing speed during the latter half. Since then the first wave and the last one both have their center at *O* the wave belt is again of uniform width; but the spacing of the waves within it is now variable both in radial directions and along the circumference. The first half of the movement being eastward, has crowded the outer waves toward east, while the latter half, being westward, has crowded the inner waves toward west. Since the pitch is governed by the spacing only, a person having the whistle east of him will hear a blast starting at low pitch and rising, while another having the whistle west of him hears a blast starting at high pitch and falling. To one north and south the waves are evenly spaced and no change in pitch is observed, the blast being uniform and of true pitch.

It is thus seen that the oscillatory movement of the source has endowed the sound-waves with properties which are of opposite character in opposite directions. In other words the sound-waves may be said to have been *polarized*, and from the character and amount of such polarization it is possible to determine the location of the whistle. It has already been shown how one blast, produced with the whistle oscillating east-west, as in Fig. 1, C, will disclose to the observer whether the whistle is east or west of him. If a second blast is now produced with a whistle oscillating north-south, the observer may determine the north-south trend from the latter blast whereby the whistle is approximately located. If, for instance, the two blasts are both rising, its location is north-east; while one falling and one rising blast would indicate north-west; one uniform and one sharply rising, due north, and so forth.

A further increase in the number of blasts and directions of movement permits the localization to be done with greater accuracy. A convenient number is eight, each movement being then at an angle of 22½° (1/16 of a full circle) to the preceding one. This number was thus used for the practical tests recently undertaken in connection with the development of the system, Fig. 2 showing graphically how such a series of eight blasts will sound to an observer having the sender in the direction indicated to the right of each group. For example, three falling and five rising blasts mean that the sender is west-northwest of him, while one rising and seven falling blasts indicate the direction south-southeast.

The table is easily memorized by bearing in mind that the character of the first blast gives the east-west trend and the predominating number of rises or falls the north-south trend. That is to say, if the first blast is rising the location of the sender is easterly (thinking of the sun rising in the east at the beginning of day, makes this easily remembered); and the greater the number of rising blasts the more northerly the location.

An oscillatory movement of the sound-source being objectionable mechanically, direct rotation at uniform speed about a horizontal axis was substituted therefor. In Fig. 3, representing a view from above of the arrangement used, *A* is the horizontal axis, about which rotates the whistle W, describing a circle *T-R* (seen edgewise) about *O* as center. By a special arrangement the whistle is blown only during half its revolution, *i.e.*, while moving through the semi-circle indicated by a full line *(O-R)*.

Starting with position *1* forming an angle with the meridian of 11¼° (1/32 of a full circle), axis *A* is given the successive positions *2, 3,....8*, one blast being produced in each. After eight blasts have thus been emitted the whistle is silent until axis *A* has been rotated on through the silent semicircle into position *1* again, whereupon the process is repeated. Each series of eight blasts is thus followed by a period of silence of about the same duration as the series itself.

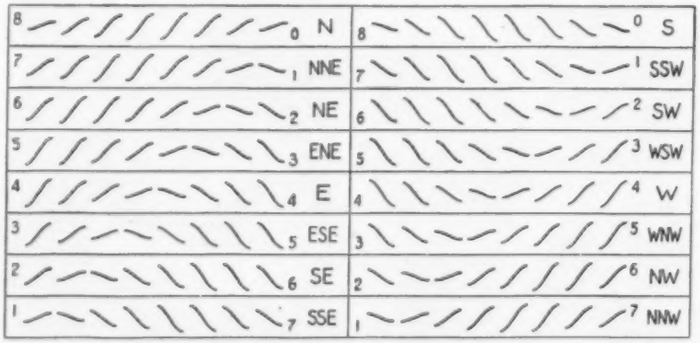


Fig. 2: How the signals will come to the observer, according to the location of the sender (rising and falling lines indicate rising and falling pitch). The whistle is assumed to be rotated as in Fig. 3

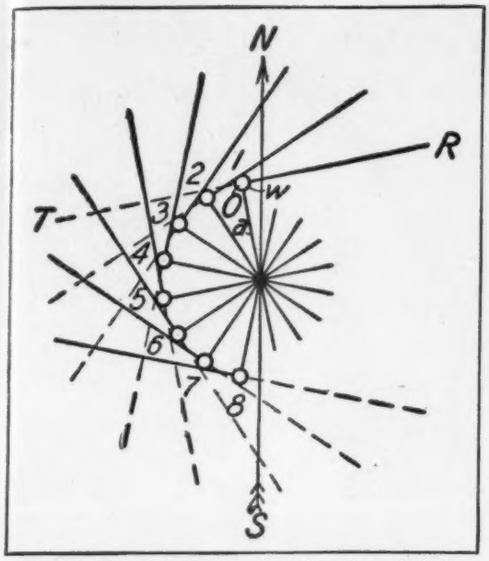


Fig. 3: The first blast comes when the axis is in position 1, and the other blasts follow at intervals of 1/16 revolution, or 22½ degrees

In the model used for the tests, and of which a photograph is given, the whistle is seen at the extreme top, at the end of the cross-arm. This is rotated by the motor seen at the base, at the rate of 90 revolutions per minute. The whistle being 5½ feet from its center of rotation, its speed is about 50 feet per second.

During the rotation of the whistle the upper frame is automatically rotated about its vertical axis at a rate sufficient to produce the required change in the direction of the horizontal axis of the cross-arm between each of the blasts. Means are also provided for adjusting the direction of the latter axis, a necessary feature for use on ships. As above stated, the axis must be at an angle to the meridian of 11¼° during the first blast of each series; when therefore the course is changed, the axis must be swung a like angle in the opposite direction to compensate for the changed position of the vessel.

As this movement is superimposed on its automatic rotation the axis can be adjusted without stopping the apparatus. If the vessel is equipped with a gyroscopic compass adjustment may be left to this.

The tests were entirely successful, no difficulty whatever being experienced in identifying a signal with its corresponding group in Fig. 2, provisions being made to exclude any possibility of visual orientation on the part of the observer. The positive nature of the observations, as compared with ordinary haphazard methods, eliminates mental strain and places the procedure on a sound routine basis.

Taking Away from a Picture to Get a Larger Picture

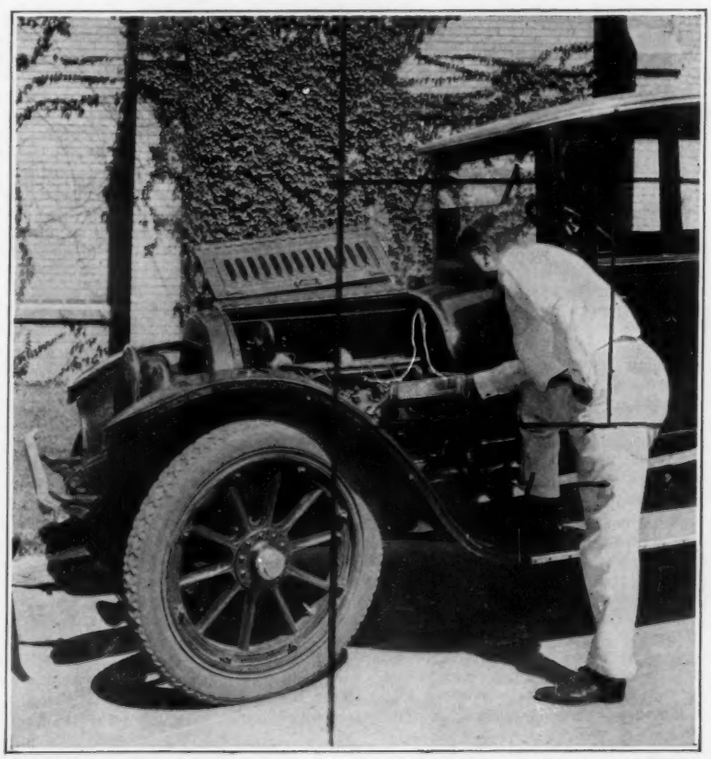
AT first reading the title of this discussion sounds all wrong, for whenever we take away from a given object, that object must become smaller. But in this case we are dealing with pictures, and every picture has a certain story to tell. It generally happens that an informative variety of picture tells its story in a very small area, while the balance of the picture is either for purposes of embellishment or is sheer waste. Hence if we remove the embellishment or waste or trimmings, whatever we may call it, we have a small remaining portion that can be enlarged materially and our real picture therefore becomes larger through this cutting, or cropping as it is called.

The growing popularity of the small sized camera, as well as the motion picture technique which is now so generally appreciated in pictorial work, is responsible for the increasing tendency to make solid pictures, so to speak. That is to say photographers are coming around to the close-up picture—the picture which tells its story and nothing else. With a large negative, say 6½ by 8½ or 8 by 10 inches, it is perhaps permissible to show a good deal of background and foreground and even sides in order to make a prettier picture, while the real center of interest is encompassed in a few square inches. But when a small negative is employed, say 2¼ or 3¼ by 4¼ inches, it is necessary to concentrate on the real "meat" of the picture, leaving out all extraneous matter even if beauty is somewhat sacrificed. This is also the case in magazine and newspaper illustrating, when space is, or should be, at a premium.

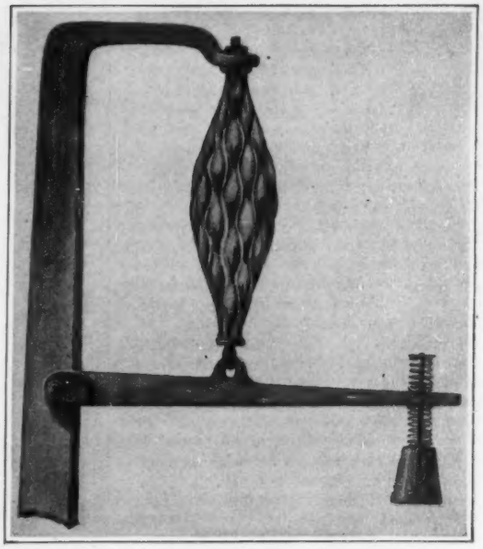
There is another factor which must be considered when using the larger sized negatives, and that is the matter of depth of focus. With long focus lenses, which are generally used with large negatives, the depth of focus is very limited when working for a close-up effect. Therefore the photographer often prefers to work farther away from the subject, taking in more of the surroundings as a consequence, but getting greater depth.

However, all that may be, we believe that technical pictures, which are made to tell a story rather than for beautiful effects, should tell their story and then stop. Let us refer to the accompanying illustration, which was taken from a large 8 by 10 print. Note that the whole story in this case is a new kind of oil can for the motorist. In considering this photograph for the SCIENTIFIC AMERICAN, we were confronted with the problem of using all the photograph and making a large cut, such as the full-sized cut here shown, making a small cut which would lose most of the detail, or taking just a small portion of the photograph, such as the section ruled off. To use the entire photograph making a cut of the size here shown would be a waste of good space, for the subject is certainly not entitled to that much space at the expense of other inventions and subjects. Hence we took but a small section, showing just the can, the man's body and arms, and enough of the automobile to give the picture a "location," so to speak.

In the preparation of the SCIENTIFIC AMERICAN we are forever cropping photographs to obtain "solid" pictures or "close-ups." Even our regular photographers and contributors are now submitting to us "solid" or "close-up" photographs, as a result. Those pretty hands which you see in some of our small cuts of inventions are as often as not the hands of a pretty girl, who appears in the original photographic print. But we must sacrifice beauty to practicability: the story, after all, is the main essential; also, it is a question of crowding the greatest amount of information into the space at our disposal. Indeed, our subjects are considered on a square-inch basis, and it is an exceptional subject that warrants a large cut.



Typical example of how space can be wasted in photographs of a technical nature. The entire story told by this picture is encompassed in the ruled-off square



A mechanical representation of the muscle as a motor

The Muscle as a Motor

By J. M. Dockstader

SUPPOSE a bag or tubular vessel to be constructed of spiral layers of wire combined with asbestos and rubber in such a manner that it were capable of expansion in circumference but not in length. If such a contrivance were hung as shown, supplied with an explosive charge of hydro-carbon gas and oxygen, and ignited by an electric spark, the resultant expansion would produce a shortening in length and the weight would be lifted.

If this bag were surrounded by water for cooling, supplied with inlet and outlet valves and suitable ignition, and the weight hung on oscillating springs, a continuous cycle could be produced very similar to that of an explosive motor—*i. e.*, explosion, exhaust, suction, compression, and repeat.

Have we not here a concept that fits most if not all the conditions which obtain in a muscle? A series of tubular cells surrounded by a fluid, supplied with hydro-carbon and oxygen, with electric terminals (nerves), and the valving supplied by diffusion of gases through membranes, and with the ends attached to a series of bony levers.

Does not the concept of explosive action in the muscles fit more of the known facts than any other?

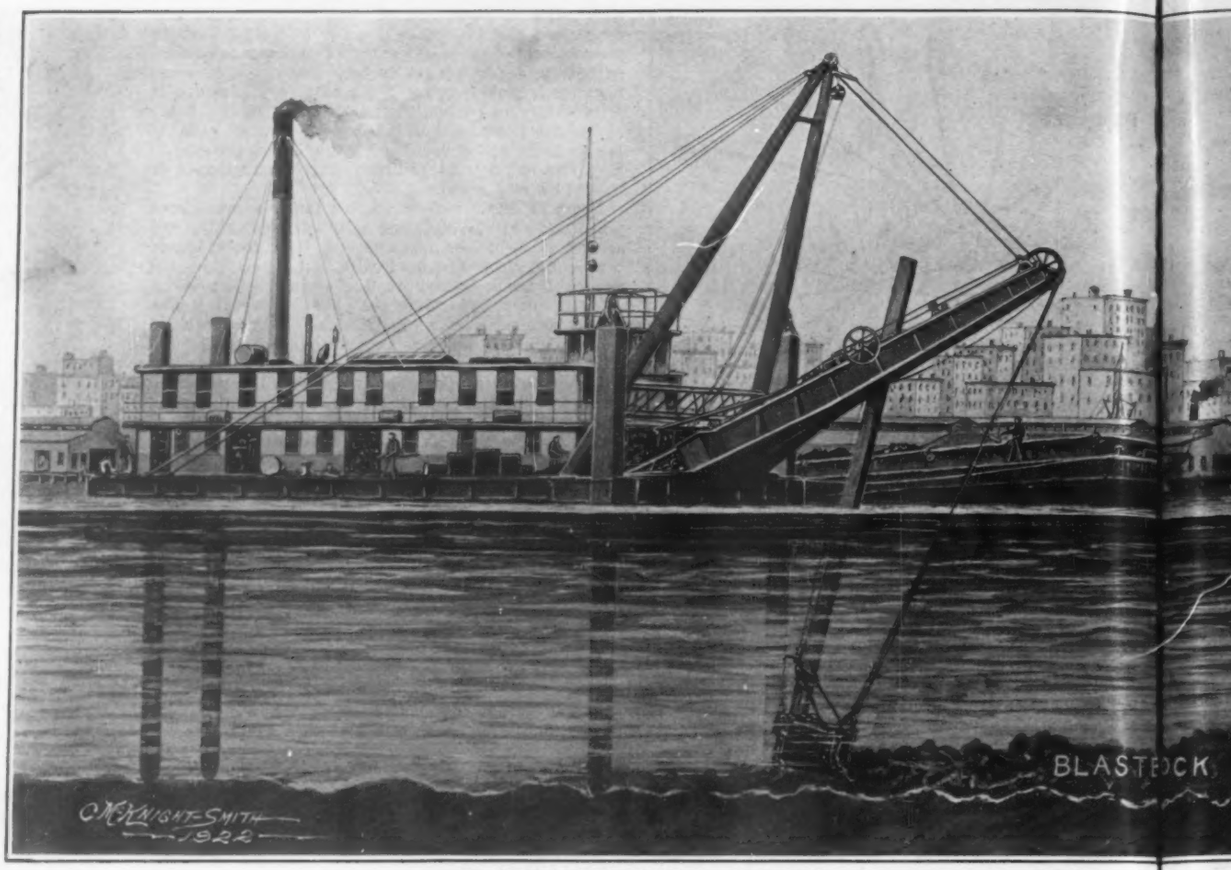
We know that a muscle is capable of being activated by galvanic action even when removed from the organism, and we know that a muscle in action has an electric current passing through it. This seems to point toward electric ignition, and the graduated action of the muscles could be produced by variations in the number of cells acted on and by the intensity of the impulse delivered by the nervous "ignition system."

That the intensity of impulse has an influence is shown by the increased muscular strength in anger or insanity and that this can be increased to the point of disruption is shown by the ruptured muscle cells when death is caused by electric shock.

The "slow oxidation" of fuel in the animal heat engine seems an attempt at analogy with the steam engine and does not fit well. Should not the analogy be rather with the explosive motor? In other words, do not the facts lead toward the conclusion that the muscle is an explosive motor in many respects similar to those which drive our automobiles?

If this is the case may we not assume that the whole process of digestion and assimilation is one of gasification, diffusion of gases through membranes, and solution of gases in liquids?

We know that this is true of the oxygen and carbon dioxide, why not also of the hydro-carbon fuel?



To the right is the drill-barge in operation; in center a mass of blasted rock; is the po

Blasting a Channel Thro a R

How New York Is Meeting the Demand of Big n Shi

QUIETLY, EXCEPT for the muffled boom of an occasional explosion, army engineers and the contractors have been engaged for several years in the arduous task of opening up a 40-foot channel through the East River, for the use of merchant shipping and the vessels of the United States Navy. In respect of the depth of water, the port of New York is greatly favored by the configuration of its various waterways and channels, for they are generally of liberal depth and width, providing free passageway, even in these days of ships of gigantic size, to and through the Hudson River. Here and there, it is true, are shallow places where dredging becomes necessary to remove accumulations of silt. It is possible for ships of large size to pass from deep water at Ambrose Light Ship to the piers in the North River at any stage of the tide; but when we turn to the East River we find obstructions in the way of reefs and rocks, which, although they gave little concern twenty-five years ago, are proving today a menace to the larger naval and merchant ships. Particularly is this true of the former; for the principal naval yard of the Atlantic Coast is located some distance up the East River, and when it comes to navigating the larger vessels, such as the "Pennsylvania" and the "Maryland," between the Navy Yard and the sea, especially if these ships are at full-load draft, they are confined to a narrow and somewhat tortuous channel, and can make the passage down the East River only at high water and at low speed.

The above considerations apply at all times; but in the event of war, when one or more of our big ships of 30,000 to 33,000 tons normal displacement might have to return to the Navy Yard in a crippled condition, due to mine or torpedo, the question of channel depth from the Battery to the Navy Yard would become of supreme importance. The maximum draft of the "Maryland," for instance, is a little over 31 feet at normal displacement, but in the event of her hull being breached by a mine, torpedo, or by grounding, her draft would be increased by several feet. It was decided that a least depth of 40 feet at mean low water was necessary to meet these conditions. Furthermore, there are merchant ships passing up and down the East River which draw at full load as much as 30 feet.

Now, before the blasting operations commenced there existed two extensive reefs of rock, one opposite Old Slip and the other between the Battery and Governor's Island. The former reef measured about 500 feet up and down stream, with a width of about 250 feet; the other is about a mile in length, and if we include occasional points of rock, may be said to cover approximately the width of the river.

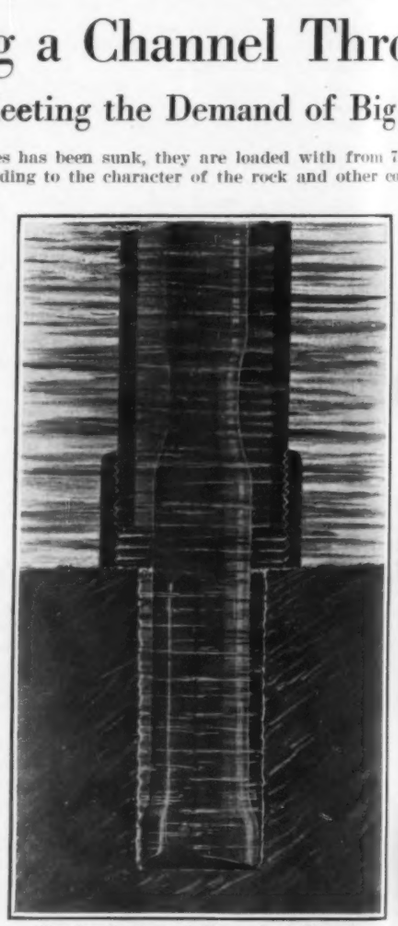
The highest point of the reef, opposite Old Slip, stood at 31 feet below mean low water, and the contract called for blasting out the reef to a uniform depth of 40 feet. The work was a complicated one and rendered very delicate by the fact that the Clark St. tunnels of the Interborough Subway passed immediately below the reef. Consequently, great care had to be taken to do no damage to the tubes. The drilling in places was carried down to within 19 feet of the outside of the tube casing; consequently, charges had to be used which were sufficiently small to avoid any damaging shock to the structure below. The work was begun in November, 1920, and was completed in August, 1922.

A more serious task, in respect of its magnitude, is the work which is now being done to secure a uniform depth of 40 feet over the extensive Diamond Reef, lying between the Battery and Governor's Island. The character of this work will be understood from the several engravings herewith presented. It is the intention of the Government to provide a channel 40 feet in depth at mean low water, 1,000 feet in width, and about one mile in total length. This does not mean that the reef everywhere projects above the 40-foot plane; on the contrary it is only over certain parts, some of considerable area and some consisting of isolated points of rock, that the blasting must be done. Nevertheless, the task is one of great magnitude, and by the time it is completed will have spread over several years.

The present contract, as will be seen from the accompanying plan, where it is shown as a darkly shaded area, is located on the southeasterly side of the proposed channel. It covers an area 150 feet wide by approximately 1,200 feet in length. The total quantity of rock to be removed is 60,000 cubic yards, of which about 30,000 cubic yards have been removed to date. Although the contract calls for a least depth of 40 feet, the Government will pay for a depth of 42 feet if the contractors wish to secure that depth. Blasting operations, such as these, naturally result in an uneven and more or less ragged bottom, and the extra 2 feet insures an absolutely clear depth to the 40-foot level.

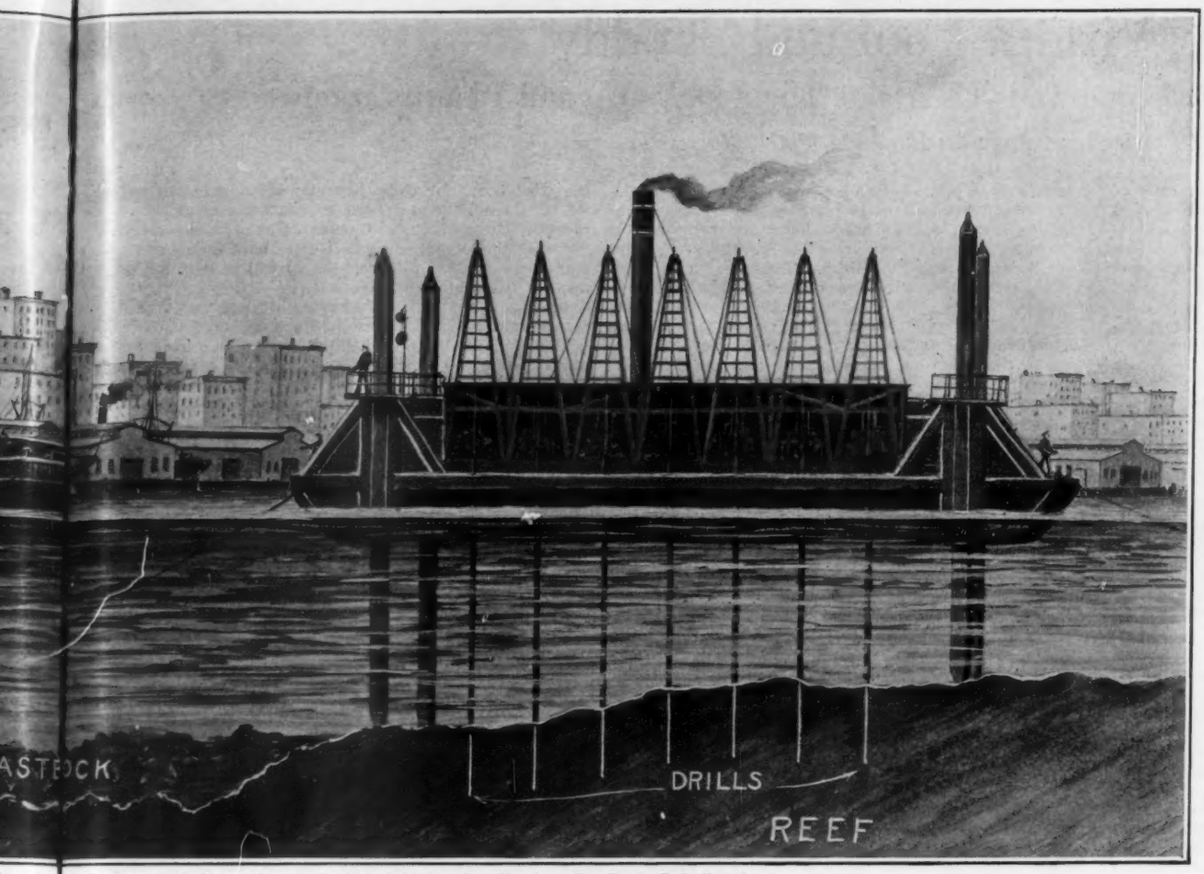
On the completion of the present contract, as shown by the dark shaded area, operations will commence on widening this 150-foot channel by an additional 200 feet, thus securing for present use a channel 40 feet in depth and 350 feet wide. The proposed ultimate 1000-foot channel will give a 40-foot depth from deep water in the upper bay to deep water in the East River beyond the reef at Old Slip.

The methods and plant by which the drilling and blasting are carried on are shown in the wash drawing at the top of this page. It consists of a drill barge and a powerful dredge. The drill barge is equipped with seven drilling derricks which are similar to those used in the drilling of oil wells. The drills are located 10 feet apart, center to center, and after a set of seven holes has been sunk, they are loaded with from 75 nge mar 100 pounds of blasting gelatin, according to the character of the rock and other con these r tions. The drill holes are sunk to a depth of 50 feet below mean low water. The Arundel Corporation of this city, which is doing the work, tells us that the drill holes are sunk to this depth with a view to being able to dredge to a clear depth of 42 feet. If the drilling were done to a less depth than 50 feet it would be difficult to make certain of being able to dredge to the 42-foot level, which, as we have shown above, is paid for by the Government if the contracting firm wishes to go to that depth. The necessity for this depth of hole is shown in one of our sketches, which represents a profile of the present river bottom where the reef reaches to within 27 feet of mean low water level. After the charge is set off the rock bottom is believed to present approximately the profile shown in our drawing, and it is only by drilling to a 50-foot depth that there is certain to be a sufficient shattering of the rock to make sure of the dredge being able to work down to the desired level.



Sectional view of the rock drill and its casing

After a line of seven holes has been drilled the drill barge is shifted back 5 to 10 feet, anchored in position, and another set of holes is drilled and shot. It should be explained that in order to enable the contractors to move the barge with accuracy, and drive the drill holes so that they will be from 5 to 10 feet apart, in either direction, the Government has set up a series

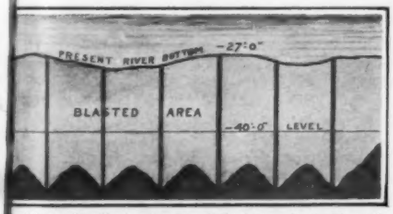


rock; is the powerful dipper-barge, built originally for digging the Cape Cod Canal

nro a River's Rocky Bottom

Big n Ships for Harbor Waterways of 40-Ft. Depth

om 75 nge marks, both on the Brooklyn shore and on Governor's Island. By sighting
er con these ranges it is possible to move the barge with sufficient accuracy to secure the required spacing of the holes over the entire area of the reef.



e blast is shot, the rock bottom is believed resent a rough contour as here shown

portion of reef through which 1000-foot channel is being blasted

Now, the tide runs very heavily at times in the East River, and although the steamers are supposed to slow down in passing the drill barge, there are some captains who follow this order "more in the breach than in the observance," and at times the barge is subject to a heavy wash from the waves of passing craft. Hence, it is necessary during the drilling to hold the barge rigidly in position. This is done by the cooperation of four "spuds," and as many heavy anchors. The "spuds" are massive, square, timbers, which are about 2 feet square, and some 80 feet in length. They slide vertically in pockets, built for them into the structure of the barge, and the lower end is heavily shod with steel. When the barge is in position and the four anchor cables have been drawn taut, part of the weight of the barge is thrown upon the four "spuds" by means of wire cables which are attached to the barge and pass over sheaves at the top of the "spuds," and then down to hoisting engines on deck. It is possible by this means to throw 50 tons or more of the weight of the barge upon the "spuds," thereby, in conjunction with the anchors, holding it rigidly during the drilling operations. In preparing for the drilling, seven iron pipes are lowered through a heavy sill at the side of the barge until they rest upon rock bottom. The drills are then lowered through these and drilling commenced. One of our engravings shows the surface of the rock, with a drill and its casing in position. The size of the hole varies according to conditions, but they run to an average size of about 6 inches.

After a stretch of the reef has been blasted down to the 50-foot level, the underlying rock is covered several feet in depth by a mass of broken material, which varies from the smallest size up to huge boulders weighing many tons. The work of getting this up and loading it into barges is done by a powerful bucket dredge, one of two which were built for digging out the Cape Cod Canal. The one here shown is known as the "Governor Warfield." It is built entirely of steel and is provided with three sizes of buckets, carrying respectively 8, 9 and 10 yards of rock. There is also a 16-yard bucket for working in sand and silt. Now, not only is much of the blasted rock in very large sizes, but the surface of the rock bottom is in a very rough and shattered condition.

It will be understood that a dipper that has to be dropped 40 feet to the bottom, and then drawn through this mass of rock and over this rough surface, has to be of unusual weight, strength and power, and everything else on the dredge in proportion. Thus the two "spuds" at the front of the dredge, which have to carry the heavy loads and great stresses of the dredging gear, and the heavy rock which is brought up, are of unusual size, and are built of heavy steel plate. They measure 3½ feet by 3½ feet in section, by 80 feet in length, and each weighs 45 tons. The steel boom, which is seen projecting from the front of the barge, weighs 90 tons. The dipper handle, reaching from the bucket up through the boom, weighs 20 tons, and the dipper weighs 12 tons and is capable of lifting 9 yards of rock, or 18 tons at each stroke. Now and then the dredge brings up much more than a load of 18 tons. Occasionally it will catch in its mouth a great fragment of rock, whose weight far exceeds that of a normal dipper load. Thus, a single mass of rock has been brought up from the Diamond Reef, which contained 28½ cubic yards, and was estimated by the engineers to weigh about 60 tons. In this case the total weight of the boom, dipper and load, ran up to 200 tons. In addition to the big steel "spuds" at the forward end of the barge, there are two smaller "spuds" at the rear which measure 2½ feet by 3 feet, and weigh 15 tons apiece. The engine that does the main hoisting has two 18 by 24-inch cylinders. The engine for raising and lowering the forward "spuds" has two 12 by 15-inch cylinders, and that for the stern "spuds" two 8 by 8-inch cylinders, while the crowding engines for moving the dipper handle in and out called for a pair of 12 by 14-inch cylinders. The hoisting cable operated by the main engine is double, each rope being 2¼ inches in diameter.

The dredged rock is dumped into hopper barges and is towed some 30 to 35 miles before it is dumped in deep water outside the Ambrose Light Ship.

Radio Direction-Finding in Flying Machines

A WRITER in *Nature*, July 8, 1922, says: There is little doubt that radio direction-finders and other radio devices will soon be in regular use to enable airplanes to land at night, during fogs or at other times of poor visibility. The usual method is to transmit signals from an antenna in the landing field to the direction-finder on the airplane. This, however, gives merely the direction of the landing field and provides no indication to the navigator of his distance from his destination.

Some years ago the Bureau of Standards in America experimented with induction signaling. A large horizontal single-turn coil, 600 by 800 feet, was erected at the landing stage. It was tuned to resonance at a frequency of 500, so that it produced a very powerful alternating magnetic field over a wide area in the neighborhood. It was found that induction effects could be detected at considerable distances when the airplane was at a low altitude, but at the height of a mile they could be detected only throughout a small area directly over the coil. The tests showed that what was wanted was a hollow conical beam of radiation, the vertex of the beam being on the landing ground. At low altitudes it was very important that the signal should be audible over only a very limited range.

This has been effected by means of two equal coaxial coils with their planes horizontal and at different altitudes. The current, which has a radio-frequency of 300,000, flows in opposite directions in the two coils. Under these conditions the signals are received at the airplane only when the machine is in the immediate neighborhood and approaching or receding from the station.

Gregory Brett, a physicist of the Bureau of Standards, has worked out mathematically the nature of the field from two horizontal coils. It is proved that the maximum intensity of the signals occurs when the angle which the line joining the airplane with the landing stage makes with the vertical is approximately 30 degrees. The region of space within which the signal can be detected is nearly the space between two inverted coaxial cones with their axes vertical and their common apex at the transmitting station. The signals are inaudible directly overhead and rapidly die away when the airplane passes through the conical surface where the sound is a maximum. The lower the airplane the louder the noise. The theoretical results have proved of value in designing stations for emitting landing signals, and should be of considerable practical importance.

high water and at low speed.

The above considerations apply at all times; but in the event of war, when one or more of our big ships of 30,000 to 33,000 tons normal displacement might have to return to the Navy Yard in a crippled condition, due to mine or torpedo, the question of channel depth from the Battery to the Navy Yard would become of supreme importance. The maximum draft of the "Maryland," for instance, is a little over 31 feet at normal displacement, but in the event of her hull being breached by a mine, torpedo, or by grounding, her draft would be increased by several feet. It was decided that a least depth of 40 feet at mean low water was necessary to meet these conditions. Furthermore, there are merchant ships passing up and down the East River which draw at full load as much as 30 feet.

Now, before the blasting operations commenced there existed two extensive reefs of rock, one opposite Old Slip and the other between the Battery and Governor's Island. The former reef measured about 500 feet up and down stream, with a width of about 250 feet; the other is about a mile in length, and if we include occasional points of rock, may be said to cover approximately the width of the river.

The highest point of the reef, opposite Old Slip, stood at 31 feet below mean low water, and the contract called for blasting out the reef to a uniform depth of 40 feet. The work was a complicated one and rendered very delicate by the fact that the Clark St. tunnels of the Interborough Subway passed immediately below the reef. Consequently, great care had to be taken to do no damage to the tubes. The drilling in places was carried down to within 19 feet of the outside of the tube casing; consequently, charges had to be used which were sufficiently small to avoid any damaging shock to the structure below. The work was begun in November, 1920, and was completed in August, 1922.

A more serious task, in respect of its magnitude, is the work which is now being done to secure a uniform depth of 40 feet over the extensive Diamond Reef, lying between the Battery and Governor's Island. The character of this work will be understood from the several engravings herewith presented. It is the intention of the Government to provide a channel 40 feet in depth at mean low water, 1,000 feet in width, and about one mile in total length. This does not mean that the reef everywhere projects above the 40-foot plane; on the contrary it is only over certain parts, some of considerable area and some consisting of isolated points of rock, that the blasting must be done. Nevertheless, the task is one of great magnitude, and by the time it is completed will have spread over several years.

The present contract, as will be seen from the accompanying plan, where it is shown as a darkly shaded area, is located on the southeasterly side of the proposed channel. It covers an area 150 feet wide by approximately 1,200 feet in length. The total quantity of rock to be removed is 60,000 cubic yards, of which about 30,000 cubic yards have been removed to date. Although the contract calls for a least depth of 40 feet, the Government will pay for a depth of 42 feet if the contractors wish to secure that depth. Blasting operations, such as these, naturally result in an uneven and more or less ragged bottom, and the extra 2 feet insures an absolutely clear depth to the 40-foot level.

On the completion of the present contract, as shown by the dark shaded area, operations will commence on widening this 150-foot channel by an additional 200 feet, thus securing for present use a channel 40 feet in depth and 350 feet wide. The proposed ultimate 1000-foot channel will give a 40-foot depth from deep water in the upper bay to deep water in the East River beyond the reef at Old Slip.

The methods and plant by which the drilling and blasting are carried on are shown in the wash drawing at the top of this page. It consists of a drill barge and a powerful dredge. The drill barge is equipped with seven drilling derricks which are similar to those used in the drilling of oil wells. The drills are located 10 feet apart, center to

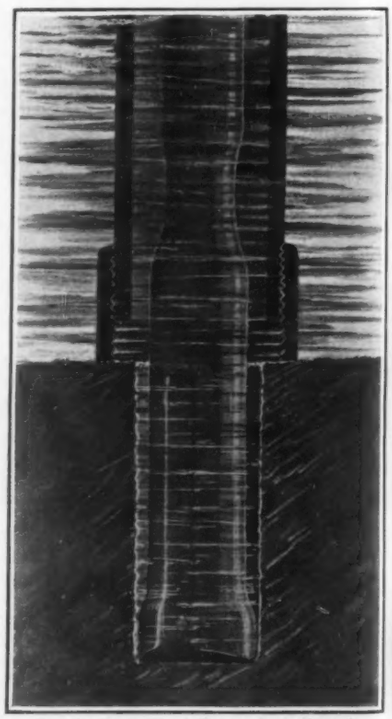
To the right is the drill-barge in operation; in center a mass of blasted rock; is the pow

Blasting a Channel Thro a R

How New York Is Meeting the Demand of Big h Ship

center, and after a set of seven holes has been sunk, they are loaded with from 75 nge mark 100 pounds of blasting gelatin, according to the character of the rock and other cond these ra tions. The drill holes are sunk to a depth of 50 feet below mean low water. The Arundel Corporation of this city, which is doing the work, tells us that the drill holes are sunk to this depth with a view to being able to dredge to a clear depth of 42 feet. If the drilling were done to a less depth than 50 feet it would be difficult to make certain of being able to dredge to the 42-foot level, which, as we have shown above, is paid for by the Government if the contracting firm wishes to go to that depth. The necessity for this depth of hole is shown in one of our sketches, which represents a profile of the present river bottom where the reef reaches to within 27 feet of mean low water level. After the charge is set off the rock bottom is believed to present approximately the profile shown in our drawing, and it is only by drilling to a 50-foot depth that there is certain to be a sufficient shattering of the rock to make sure of the dredge being able to work down to the desired level.

After a line of seven holes has been drilled the drill barge is shifted back 5 to 10 feet, anchored in position, and another set of holes is drilled and shot. It should be explained that in order to enable the contractors to move the barge with accuracy, and drive the drill holes so that they will be from 5 to 10 feet apart, in either direction, the Government has set up a series



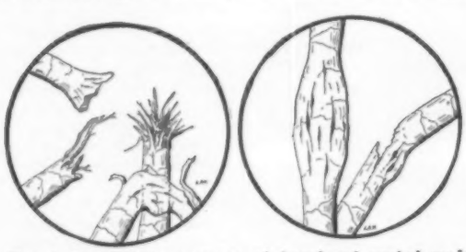
Sectional view of the rock drill and its casing

Virgin Wool and Shoddy

What the Microscope Tells Us About Their Make-Up and Identification

By Leon Augustus Hausman, Ph.D., Rutgers College

ONE OF the most valuable departments of applied microscopic work is that concerned with the examination and analysis of textiles. The comparative ease with which fabrics can be made to yield up the secrets of the source of their component materials has raised this method of analysis to a place of premier importance among the many applied aspects of microscopy. The applications of microscopical examination to textile analysis are many and varied, and frequently



Figs. 1, 2: Typical appearance of frayed and crushed wool hairs in a shoddy fabric. Compare these with the appearance of the virgin wool in Fig. 3, where there is no suggestion of

recognized: (1) *Shoddy proper*, which is the best grade of recovered wool. This is salvaged from rags which have not been felted, and whose fibers are therefore not very much injured after tearing the fabric apart. From such fibers, especially if they are mixed with a small percentage of long virgin wool fibers, a fairly good grade of woolen cloth may be obtained. (2) *Mungo* is obtained from felted or fulled goods. In tearing such a firm material apart considerable damage may be done to the individual fibers. They may be variously broken, frayed and splintered, and present those characteristic appearances under the microscope which are so useful in the identification of shoddy fibers (Figs. 1 to 6). (3) *Extract wool*, recovered from wool and cotton mixtures by treatment with sulfuric acid or some other carbonizing reagent which removes the cotton and leaves the wool. Such treatment often corrodes the cuticular scales of the wool hairs (Fig. 4) and gives the shaft of the hair a smooth and homogeneous appearance which distinguishes it at once from the shaft of the hair of virgin wool with its cuticular scales intact. All of these recovered products may be spoken of under the general term, shoddy.

In testing under the microscope for the presence of shoddy, the sample under examination is first carefully brushed with a stiff brush, and the resulting loose frag-

the wool fibers for dyes they may be mounted in any one of these light oils, such as wintergreen oil, oil of cayeput, clove oil, etc. Canada balsam is also used. This has the advantage that it dries hard and forms a permanent mount of the specimen, which, however, is apt to deteriorate with age.

In Figs. 9 and 10 are shown two devices very useful for the examination of textile fibers. The comparison ocular, indeed, is well nigh indispensable. This apparatus (Fig. 9) permits the bringing into the same

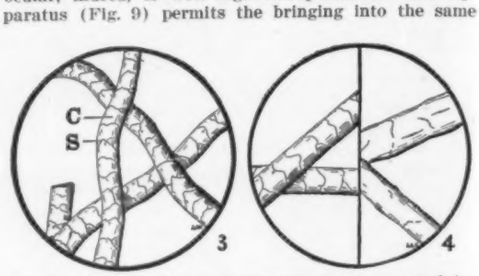


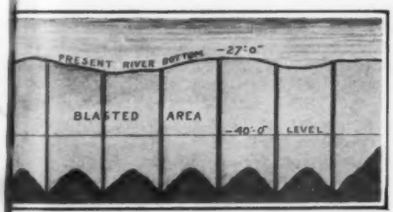
Fig. 3: Virgin wool immediately after shearing, washed in ether-alcohol and mounted dry. *C* is the cortex and *S* the cuticular scales. Fig. 4: Virgin wool (left) and shoddy

d rock; is the powerful dipper-barge, built originally for digging the Cape Cod Canal

hro a River's Rocky Bottom

Big h Ships for Harbor Waterways of 40-Ft. Depth

from 75 nge marks, both on the Brooklyn shore and on Governor's Island. By sighting ther cond these ranges it is possible to move the barge with sufficient accuracy to secure the required spacing of the holes over the entire area of the reef.



e blast is shot, the rock bottom is believed resent a rough contour as here shown

portion of reef through which 1000-foot channel is being blasted

Now, the tide runs very heavily at times in the East River, and although the steamers are supposed to slow down in passing the drill barge, there are some captains who follow this order "more in the breach than in the observance," and at times the barge is subject to a heavy wash from the waves of passing craft. Hence, it is necessary during the drilling to hold the barge rigidly in position. This is done by the cooperation of four "spuds," and as many heavy anchors. The "spuds" are massive, square, timbers, which are about 2 feet square, and some 80 feet in length. They slide vertically in pockets, built for them into the structure of the barge, and the lower end is heavily shod with steel. When the barge is in position and the four anchor cables have been drawn taut, part of the weight of the barge is thrown upon the four "spuds" by means of wire cables which are attached to the barge and pass over sheaves at the top of the "spuds," and then down to hoisting engines on deck. It is possible by this means to throw 50 tons or more of the weight of the barge upon the "spuds," thereby, in conjunction with the anchors, holding it rigidly during the drilling operations. In preparing for the drilling, seven iron pipes are lowered through a heavy sill at the side of the barge until they rest on unusual size, and are built of heavy steel plate. They measure 3½ feet by 3½ feet in section, by 80 feet in length, and each weighs 45 tons. The steel boom, which is seen projecting from the front of the barge, weighs 90 tons. The dipper handle, reaching from the bucket up through the boom, weighs 20 tons, and the dipper weighs 12 tons and is capable of lifting 9 yards of rock, or 18 tons at each stroke. Now and then the dredge brings up much more than a load of 18 tons. Occasionally it will catch in its mouth a great fragment of rock, whose weight far exceeds that of a normal dipper load. Thus, a single mass of rock has been brought up from the Diamond Reef, which contained 28½ cubic yards, and was estimated by the engineers to weigh about 60 tons. In this case the total weight of the boom, dipper and load, ran up to 200 tons. In addition to the big steel "spuds" at the forward end of the barge, there are two smaller "spuds" at the rear which measure 2½ feet by 3 feet, and weigh 15 tons apiece. The engine that does the main hoisting has two 18 by 24-inch cylinders. The engine for raising and lowering the forward "spuds" has two 12 by 15-inch cylinders, and that for the stern "spuds" two 8 by 8-inch cylinders, while the crowding engines for moving the dipper handle in and out called for a pair of 12 by 14-inch cylinders. The hoisting cable operated by the main engine is double, each rope being 2¼ inches in diameter.

The dredged rock is dumped into hopper barges and is towed some 30 to 35 miles before it is dumped in deep water outside the Ambrose Light Ship.

Radio Direction-Finding in Flying Machines

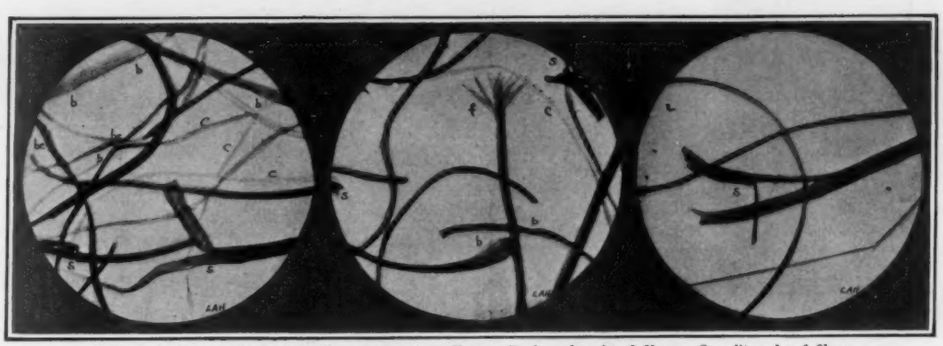
A WRITER in *Nature*, July 8, 1922, says: There is little doubt that radio direction-finders and other radio devices will soon be in regular use to enable airplanes to land at night, during fogs or at other times of poor visibility. The usual method is to transmit signals from an antenna in the landing field to the direction-finder on the airplane. This, however, gives merely the direction of the landing field and provides no indication to the navigator of his distance from his destination.

Some years ago the Bureau of Standards in America experimented with induction signaling. A large horizontal single-turn coil, 600 by 800 feet, was erected at the landing stage. It was tuned to resonance at a frequency of 500, so that it produced a very powerful alternating magnetic field over a wide area in the neighborhood. It was found that induction effects could be detected at considerable distances when the airplane was at a low altitude, but at the height of a mile they could be detected only throughout a small area directly over the coil. The tests showed that what was wanted was a hollow conical beam of radiation, the vertex of the beam being on the landing ground. At low altitudes it was very important that the signal should be audible over only a very limited range.

This has been effected by means of two equal coaxial coils with their planes horizontal and at different altitudes. The current, which has a radio-frequency of 300,000, flows in opposite directions in the two coils. Under these conditions the signals are received at the airplane only when the machine is in the immediate neighborhood and approaching or receding from the station.

Gregory Brett, a physicist of the Bureau of Standards, has worked out mathematically the nature of the field from two horizontal coils. It is proved that the maximum intensity of the signals occurs when the angle which the line joining the airplane with the landing stage makes with the vertical is approximately 30 degrees. The region of space within which the signal can be detected is nearly the space between two inverted coaxial cones with their axes vertical and their common apex at the transmitting station. The signals are inaudible directly overhead and rapidly die away when the airplane passes through the conical surface where the sound is a maximum. The lower the airplane the louder the noise. The theoretical results have proved of value in designing stations for emitting landing signals, and should be of considerable practical importance.

tained from many different sources; i. e., rags and cuttings from different fabrics. If, where such fibers occur, there also appear short pieces and torn ends the presence of shoddy is beyond doubt. In some shoddies the fibers may be redyed. In such cases heating the sample mounted on the microscopic slide in caustic potash or dilute hydrochloric acid, will reduce the second dye and leave the fibers with the original colors imparted to them in the first dyeing. Fig. 7 shows a photomicrograph of shoddy in a sample purporting to be new wool, the fibers being yellow, red, blue and black. Such shoddy is probably the shoddy proper, obtained from rags which have not been felted, since the torn ends and bruised spots were not numerous. The sample, moreover, showed the presence of many cotton fibers. It must be remembered that even in fabrics composed entirely of virgin wool there will be found fibers which have undergone mutilation of one kind and another, hence the presence of some of the characters typical of shoddy which we have been describing may be found, in very small measure however, in some of these fabrics.



B, bruised places. *Be*, broken fibers. *C*, cotton fibers. *F*, frayed ends of fibers. *S*, split ends of fibers

Fig. 6: Photomicrographs of typical shoddy textiles, showing the characteristics of cotton fiber and damaged wool present

No one of the typical shoddy characteristics alone (except, perhaps the presence of multi-colored fibers) is sufficient

bits of coke float on the surface and are carried off by the strong current. In this manner clinkers and cinders are separated. The coke thus sorted out passes on an endless belt transporter and is quickly picked off by workmen. Collected into heaps it is ready for sale and use.

Meanwhile the fine dust and small bits of cinders have been carried to large rapidly revolving drums equipped with magnetic apparatus. Magnetized steel bands about the width of a man's hand run close to

The sticky hot paste is carried to revolving drums with openings about four inches in diameter. In these drums the paste is first compressed by short steel pistons, then expelled by another set of pistons. The finished product, fuel briquettes about the size of a man's fist, can soon be seen falling five at a time, steaming hot, from the two revolving drums upon a slide that carries them into the open and to the loading platform.

It has been calculated that thirteen plants built along the line of the one at Eldelstedt would have a capacity for treating 420,000 metric tons of waste fuel. This would mean the reclaiming of 164,000 tons of good coke with an average heating value of 5500 calories. Besides, the 63,000 tons of fine coke-dust and culm yielded by the dry-magnetic process could be used, with the addition of coal dust and pitch, to produce about 74,000 fuel briquettes with a value of about 6500 calories.

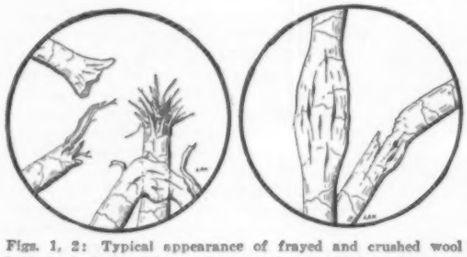
In other railroad administration districts of Germany—at Cassel, Erfurt, Hannover, Frankfort, Cologne and Treves—similar plants for the treatment of cinders have been established. In some of these plants the combination of the wet and dry process has been abandoned and the waste material is separated into reclaim-

Virgin Wool and Shoddy

What the Microscope Tells Us About Their Make-Up and Identification

By Leon Augustus Hausman, Ph.D., Rutgers College

ONE OF the most valuable departments of applied microscopic work is that concerned with the examination and analysis of textiles. The comparative ease with which fabrics can be made to yield up the secrets of the source of their component materials has raised this method of analysis to a place of premier importance among the many applied aspects of microscopy. The applications of microscopical examination to textile analysis are many and varied, and frequently lead the microscopist into other fields of study than pure science. For example, the writer was recently requested by a historian to examine a series of samples of primitive textile fabrics from Indian graves in Argentina and Chile for the purpose of determining whether sheep wool had entered into their composition, an element whose presence would have aided in the interpretation of certain historical facts concerned with the original inhabitants of these countries.



Figs. 1, 2: Typical appearance of frayed and crushed wool hairs in a shoddy fabric. Compare these with the appearance of the virgin wool in Fig. 3, where there is no suggestion of fraying or crushing

What shoddy looks like under the microscope

In the examination of woolen goods to determine the nature of the fabric it must be borne in mind that such goods are made up either of wool fibers derived directly from the sheep and used as fresh textile material—termed virgin wool; or of fibers obtained from woolen rags and wastes of various sorts by tearing these up and converting their fibres again into loose materials. These may be then re-woven into fabrics either with or without the admixture of fresh wool, cotton, etc. Such rewoven fabrics are known as shoddies. The industry of converting old woolens into shoddies of various sorts has, of late, grown to very large proportions. Nearly all of the cheaper woolen goods contain a high percentage of these inferior fibers, and are hence less durable than the more expensive ones composed of long, unmutilated fibers of virgin wool. However, there are various grades of shoddies, and some of the best grades are but little inferior, if at all, to some of the poorer fabrics of virgin wool. It is important, therefore, that the microscopist should be able to distinguish indubitably between the appearance of the fibers composing virgin wool and shoddy fabrics, and to be able to detect the presence of shoddy fibers in whatever sort of fabric they may occur.

The micro-analysis of woolens is carried on usually for the purpose of answering the following questions: (1) Is a given sample composed of virgin wool, or is it composed wholly or in part (and what is the percentage) of shoddy? (2) Does it contain other kinds of animal hairs, or vegetable fibers? (3) Are several different samples from the same piece of goods? (4) Are the fibers dyed or of natural color? and (5) Have the fibers composing the sample been redyed, and if so what was the color of the first dye? These questions can in most cases be answered by the microscope, after various treatments of the samples to bring out various characteristic reactions in the fibers.

The wool recovered from woolen rags and waste and termed either recovered or regenerated wool, varies considerably according to the nature of the rags and the methods employed to reduce them to loose fibers. Three principal grades of recovered wools are generally recognized: (1) *Shoddy proper*, which is the best grade of recovered wool. This is salvaged from rags which have not been felted, and whose fibers are therefore not very much injured after tearing the fabric apart. From such fibers, especially if they are mixed with a small percentage of long virgin wool fibers, a fairly good grade of woolen cloth may be obtained. (2) *Mungo* is obtained from felted or fulled goods. In tearing such a firm material apart considerable damage may be done to the individual fibers. They may be variously broken, frayed and splintered, and present those characteristic appearances under the microscope which are so useful in the identification of shoddy fibers (Figs. 1 to 6). (3) *Extract wool*, recovered from wool and cotton mixtures by treatment with sulfuric acid or some other carbonizing reagent which removes the cotton and leaves the wool. Such treatment often corrodes the cuticular scales of the wool hairs (Fig. 4) and gives the shaft of the hair a smooth and homogeneous appearance which distinguishes it at once from the shaft of the hair of virgin wool with its cuticular scales intact. All of these recovered products may be spoken of under the general term, shoddy.

In testing under the microscope for the presence of shoddy, the sample under examination is first carefully brushed with a stiff brush, and the resulting loose fragments of hairs collected and set aside for further treatment. Next several threads from the warp and the woof are individually reduced to their component loose fibers by carefully teasing them out with needles and forceps. The writer has found that this can be most satisfactorily done under a solution of equal parts of ether (or chloroform) and 95 per cent alcohol. This same solution is used to wash the hairs thoroughly to clean from them any oily matter and dirt. They are then thoroughly dried in a current of warm air, mounted between two thin white-glass microscope slides, and examined dry. This is the simplest method of determining the nature of the cuticular scales. In wool hairs this is an important character. Fig. 3 shows the appearance of virgin wool, immediately after shearing. Each individual hair shaft is composed of a central core, or rod known as the cortex (C), made up of closely compacted elongated cells, so closely applied as to form, in effect, an almost homogeneous rod; and an outer investiture of thin, imbricate scales, known as the cuticular scales (S). In some shoddies, to some extent in the shoddy proper, to a greater extent in Mungo, and very largely in extract, these may be torn, corroded, or otherwise mutilated.

The hairs or fibers to be examined may also be mounted in various media. Mounting for microscopic examination consists in placing upon the fibers on the slide a drop or two of the mounting medium and then covering the whole with a thin glass square, known as the cover-glass. Water makes a good mount for many textile fibers, but ether, chloroform, alcohol, xylol, and various microscopic oils are also used. In examining the wool fibers for dyes they may be mounted in any one of these light oils, such as wintergreen oil, oil of cayeput, clove oil, etc. Canada balsam is also used. This has the advantage that it dries hard and forms a permanent mount of the specimen, which, however, is apt to deteriorate with age.

In Figs. 9 and 10 are shown two devices very useful for the examination of textile fibers. The comparison ocular, indeed, is well nigh indispensable. This apparatus (Fig. 9) permits the bringing into the same circular microscopic field, and under the same conditions of illumination and magnification, two separate samples on different slides (Fig. 4). This enables one to make delicate comparisons under high powers of magnification. The dichromatic (or double-colored) illumination apparatus (Fig. 10) was devised by the writer for viewing the object on the microscope stage by two separate lights of complementary colors at the same time. Light of one color is thrown up through the specimen from below by means of the microscope mirror, thus illuminating the transparent portions of the specimen; while light of another color—usually the complementary one—is thrown down upon the specimen from above, thus illuminating the opaque portions of the specimen. By this means obscure structures may frequently be rendered more easily visible, and identifications made more certain. The illuminants are small arc lamps (A1 and A2) and the colored light filters are borne in slides (S1 and S2).

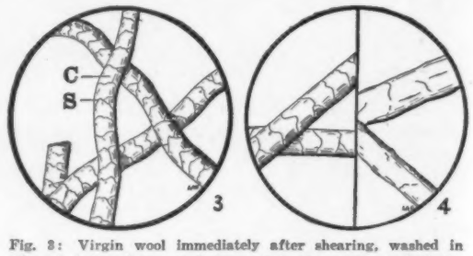
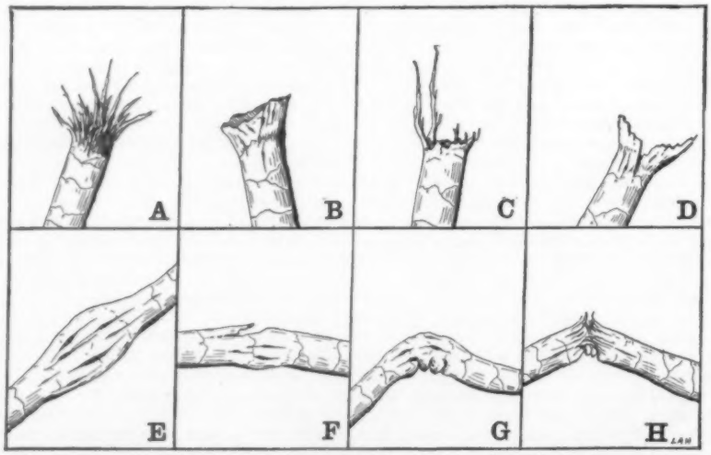


Fig. 3: Virgin wool immediately after shearing, washed in ether-alcohol and mounted dry. *C* is the cortex and *S* the cuticular scales. Fig. 4: Virgin wool (left) and shoddy (right) seen together in the comparison ocular

The striking contrast presented by virgin wool

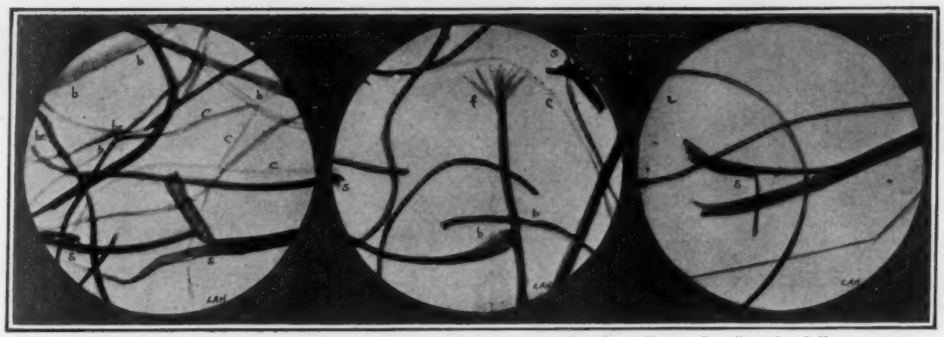


The upper row, *a* to *d*, shows characteristic frayed and torn ends, while the lower, *e* to *h*, reveals fibers bruised but not actually torn. Such injuries as these are the inevitable results of the shredding of the original fabric to obtain the wool for reweaving

Fig. 5: Typical appearances of the sheep-wool fibers found in shoddy

Now as to the microscopic character of shoddy fibers which enables us to distinguish them from fibers of virgin wool. As a rule a shoddy will show the presence of many short fibers, with cleanly truncated ends, the result of cutting up the original goods; or of many fibers with torn, frayed and fringed ends (Figs. 1 to 6), the result of tearing and combing out. There may likewise be fibers present with bruised or crushed places, the cortex being split at such places, and the empty spaces appearing, if the fibers are mounted in oil, as dark streaks. Or the fibers may be variously bent and fractured. Again there may be a striking lack of uniformity in the diameters of the individual fibers, indicating a multitude of sources for the fibers in the sample (Fig. 7). The presence of a large number of cotton threads is often an indication of shoddy. However, the presence of a large number of fibers with differently shaped cuticular scales, indicating the presence of wools from different breeds of sheep, is not necessarily indicative of shoddy, since it is sometimes customary to mingle several different types of wool. Many shoddies, especially those made up from extract wool, contain fibers lacking the cuticular scales, either wholly or in part. In such shoddies also, the fibers, from too long contact with the carbonizer which removed the cotton from the original rags, may be swollen or otherwise distorted. One of the surest criteria, if not indeed the surest criterion for the presence of shoddy, however, is the appearance of fibers of different colors in a yarn which by ocular examination is apparently composed of fibers of one color. This is almost always an indication that the material was ob-

tained from many different sources; i. e., rags and cuttings from different fabrics. If, where such fibers occur, there also appear short pieces and torn ends the presence of shoddy is beyond doubt. In some shoddies the fibers may be redyed. In such cases heating the sample mounted on the microscopic slide in caustic potash or dilute hydrochloric acid, will reduce the second dye and leave the fibers with the original colors imparted to them in the first dyeing. Fig. 7 shows a photomicrograph of shoddy in a sample purporting to be new wool, the fibers being yellow, red, blue and black. Such shoddy is probably the shoddy proper, obtained from rags which have not been felted, since the torn ends and bruised spots were not numerous. The sample, moreover, showed the presence of many cotton fibers. It must be remembered that even in fabrics composed entirely of virgin wool there will be found fibers which have undergone mutilation of one kind and another, hence the presence of some of the characters typical of shoddy which we have been describing may be found, in very small measure however, in some of these fabrics.



B, bruised places. *Be*, broken fibers. *C*, cotton fibers. *F*, frayed ends of fibers. *S*, split ends of fibers

Fig. 6: Photomicrographs of typical shoddy textiles, showing the characteristics of cotton fiber and damaged wool present

No one of the typical shoddy characteristics alone (except, perhaps the presence of multi-colored fibers) is sufficient to determine whether shoddy is present. In most shoddies several of the microscopic characters will occur together, and the determination will be thus made more certain. However, the analysis of woolens is not an easy task, but one requiring the exercise of a quality of mind by no means easy to cultivate or retain: patience.

Treasures from Cinders

GERMANY, once the leading country of continental Europe in the matter of coal lands, is now compelled to economize her coal to the utmost. For some time past the several railroad administrations have been at work on projects for the extraction from locomotive cinders of all those particles of fuel that can still be utilized for heating purposes.

Quite recently a plant for the treatment of locomotive cinders has been put in operation at Eidelstedt, a suburb of Hamburg, and there are plans on foot to establish fully a dozen such plants at Altona, Stettin, Schwerin, Berlin, Halle, Magdeburg and Dresden—all of these cities being railroad centers—where new values will be created out of waste fuel from the heating system of railroad locomotives.

Now, how does such a plant as the one at Eidelstedt work?

Railroad cars on sidings deliver the locomotive cinders forming the raw material for the process. (It may be added here that the railroad administration has 40 per cent interest in the plant.) A large tipping mechanism empties the cars depositing their contents upon a huge grate. Lumps too large in size are reduced until they pass upon the huge grate downward into pits. From these the cinders are raised by an elevator to the highest point of the plant and dropped into great revolving drum sieves that sort out the fine material (from dust to grains about four-fifths of an inch in diameter), while the coarser pieces pass over a sliding plane into a container. Through this latter water is run at high velocity and kept in a vibrating motion by a mechanical shaker. Clinkers, having a high specific gravity sink to the bottom of this container. The lighter particles or partly burned cinders and small bits of coke float on the surface and are carried off by the strong current. In this manner clinkers and cinders are separated. The coke thus sorted out passes on an endless belt transporter and is quickly picked off by workmen. Collected into heaps it is ready for sale and use.

Meanwhile the fine dust and small bits of cinders have been carried to large rapidly revolving drums equipped with magnetic apparatus. Magnetized steel bands about the width of a man's hand run close to one another around the brass drums. Upon these bands the fine material culm and dust falls through small openings in a continuous trickle. The magnetized bands hold fast the burnt-out cinders and slag; these are brushed off further on in the machinery. But the magnetism of the steel bands does not affect those particles that still are combustible. These latter fall forward beyond the brass drums, being then cleaned and sifted before they are ready for further treatment. They are placed into a mixing vessel and cooked to a tough paste after pitch has been added as a cementing material. The sticky hot paste is carried to revolving drums with openings about four inches in diameter. In these drums the paste is first compressed by short steel pistons, then expelled by another set of pistons. The finished product, fuel briquettes about the size of a man's fist, can soon be seen falling five at a time, steaming hot, from the two revolving drums upon a slide that carries them into the open and to the loading platform.

It has been calculated that thirteen plants built along the line of the one at Eidelstedt would have a capacity for treating 420,000 metric tons of waste fuel. This would mean the reclaiming of 164,000 tons of good coke with an average heating value of 5500 calories. Besides, the 63,000 tons of fine coke-dust and culm yielded by the dry-magnetic process could be used, with the addition of coal dust and pitch, to produce about 74,000 fuel briquettes with a value of about 6500 calories.

In other railroad administration districts of Germany—at Cassel, Erfurt, Hannover, Frankfort, Cologne and Treves—similar plants for the treatment of cinders have been established. In some of these plants the combination of the wet and dry process has been abandoned and the waste material is separated into reclaimable fuel and slags by a special electromagnetic process. The larger pieces of coke are picked from the slags by special machinery; and the slag is worked into building bricks.

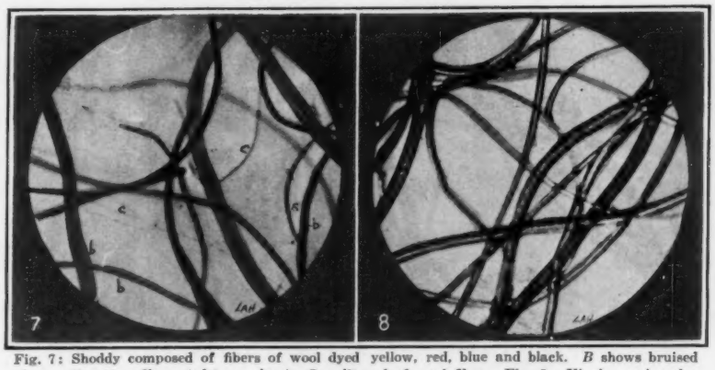


Fig. 7: Shoddy composed of fibers of wool dyed yellow, red, blue and black. *B* shows bruised places; *C*, cotton fibers (of two colors); *S*, split end of wool fiber. Fig. 8: Virgin wool under the same magnification as Fig. 7. Note the absence of bends, breaks, bruised places and frayed ends. The color was uniform, and the sample showed that of a majority of the fibers the scales were intact

Another instance of the deadly parallel

Weather Bureau Data Aid in Chimney Construction

ENGINEERS charged with the building and remodeling of scores of heating and coal-consuming power plants in Salt Lake City have called on the Weather Bureau of the United States Department of Agriculture for data to assist them in making plans for the new structures following a new city ordinance, aimed at the reduction of the smoke nuisance. The barometric pressure for Salt Lake City, which is 4350 feet above sea level, averages from 25.60 to 25.70 inches through the winter months. The average atmospheric pressure at approximately sea-level localities is about 28.90 inches. Where the air is rare a greater volume must be furnished to supply the amount of oxygen required. This increase can be obtained by increasing the velocity of the air taken in or the size of the opening through which it is received.

Death of Professor W. C. Peckham

THOUSANDS of our readers were indebted to Professor W. C. Peckham, who for more than twenty-five years answered our electrical queries and those relating to general science. He was a true teacher and no pains were too great to elucidate his answers. He was also one of the Contributing Editors of this journal. Professor Peckham was born in 1841, so that in his long life he was able to see the development of most of our modern inventions from their inception to their fruition. He was a great traveler and had made a trip around the world to add to his store of knowledge. He was instructor and later Professor of Physics in Adelphi College, Brooklyn, since 1875. He was an excellent astronomer, an expert microscopist and photographer. Only last year he held the high office of Adjutant General of the Grand Army of the Republic. He was a man of great breadth of view, and he retained his faculties to the last.

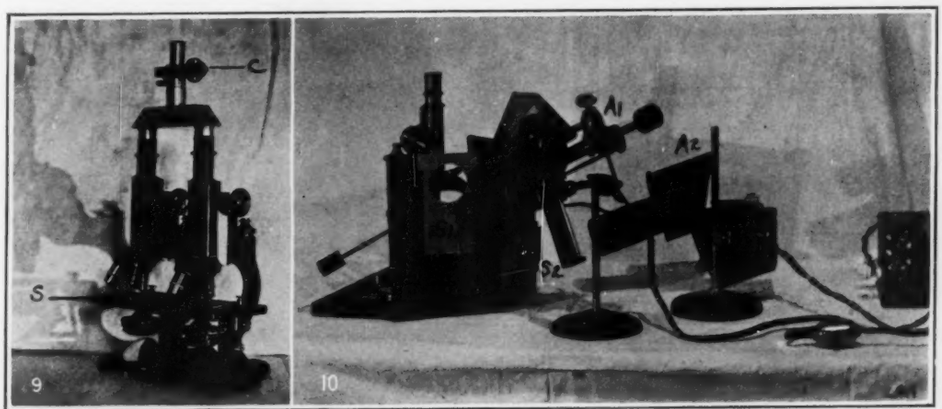


Fig. 9: Two microscopes fitted with the comparison ocular. The screw at *C* regulates a measuring device. *S* is the stage. By means of this ocular two different samples, one under the lens of each instrument, may be brought side by side into the one visual field as shown in Fig. 4. Fig. 10: The author's dichromatic illumination apparatus, for viewing objects under the microscope with light of two colors simultaneously. This aids greatly in bringing out otherwise obscure structures in hairs and other fibers

Typical tools of the microscopist who specializes in commercial examinations

James Playfair McMurrick

By Marcus Benjamin, Ph.D.

ONCE, and once only, in the past has the American Association for the Advancement of Science chosen for its president one who lived beyond the borders of the United States. In 1881, at the Montreal meeting, Sir William Dawson, famous as the director of the Canadian Geological Survey, had that honor conferred on him. This year at the Toronto meeting, in worthy appreciation of the great advances made by science in Canada, a distinguished worker in the biological sciences, residing in Toronto, received that most honorable recognition.

James Playfair McMurrick is distinctly a Canadian, for he was born in Toronto on October 16, 1859, and was educated at Upper Canada College, an institution in his native city that was founded in 1829 by Sir John Simcoe, then governor of Upper Canada, and at the University of Toronto, where he came under the stimulating influence of Prof. R. Ramsay Wright, who held the chair of biology at that time. He received the degree of bachelor of arts in 1879 and that of master in 1881; and then for two years studied medicine. But the urge of the biological sciences persisted and he was called to the office of biologist in the Ontario Agricultural College, where he remained for three years.

In 1884 he gladly accepted a call to the Johns Hopkins University, where splendid opportunities for higher studies were offered him under those great teachers in biology, H. Newell Martin and William K. Brooks, and from which institution he received the well-earned and worthily bestowed doctorate of philosophy in 1885.

With the prestige of his recognized ability, opportunities for advancement quickly presented themselves to him; and so during 1886-9 he was professor of biology at Haverford College, then he went to Clark University where he was a docent and assistant professor of animal morphology for three years, but upward and onward his path led him and the chair of biology was his at the University of Cincinnati in 1892-1904, and that of anatomy at the University of Michigan in 1904-07.

Rich in accumulated knowledge and ripe in experience, he returned to his Alma Mater in 1907, where he has since remained as University professor, but while ever busy with the work of his own special department, he has found time to devote his attention to the furtherance of post-graduate study, for he is also chairman of the Board of Graduate Studies.

From busy men much is expected, and ever and always more is given to them to do. Although teaching has been Professor McMurrick's chief work, nevertheless he has contributed very largely by original investigation to the development of his specialties. At first these had to do with the morphology of fishes, but later he turned his attention to invertebrate forms, taking up specially the Actiniaria, concerning whose morphology, development and phylogeny he has published extensively.

He has also been called upon to study and report on important collections of these forms that have been gathered by the U. S. Bureau of Fisheries steamer "Albatross," the Plate Expedition to South America, the famous "Siboga" Expedition, as well as several others. He has likewise given conspicuous attention to the morphology of the mollusca and crustacea, and more recently to vertebrate morphology, resulting in a series on the morphology of the limb musculature.

With age comes breadth of vision and study begets thought, and so there has come to him in natural sequence, generalization, and he has found expression in the growing interest in the study of the History of Scientific Thought, to which his published contributions have received more than passing consideration.

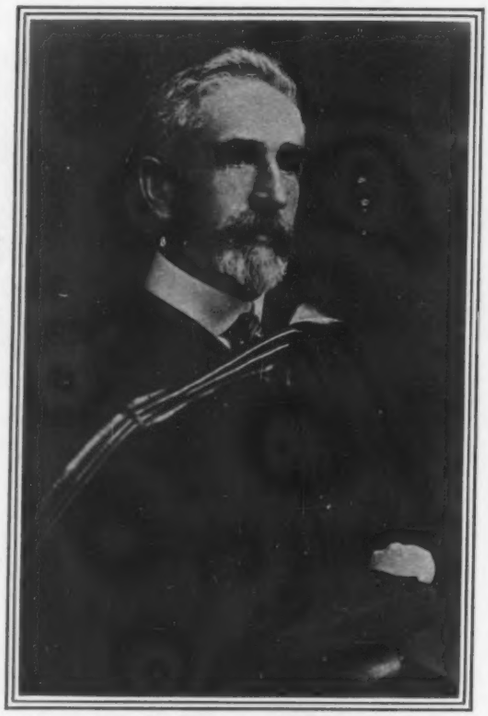
His extensive bibliography has been given to the world through many channels; as, for instance, the reports on collections have appeared in the publications of the Bureau of Fisheries and other similar official reports, while his papers on anatomy have properly appeared in the *American Journal of Anatomy*. Credit must also be given him for a text-book on "Invertebrate Zoology (1894)," of which two editions have been issued, and for "The Development of the Human Body (1902)," of which six editions have been called for, and he has been a contributor or collaborator in several text-books on anatomy.

Professor McMurrick served as an instructor at the Marine Biological Laboratory in Woods Hole during 1887-91, and was one of the trustees of that institution during 1892-96; and he has also been a member of the Advisory Board of the Wistar Institute. A later service of kindred nature is his appointment by the Dominion Government as a member of the Biological Board of Canada, which has for its object the direction and supervision of the Government Biological Stations, and to him has been assigned the editorship of its publications.

In recognition of his contributions to science the University of Michigan in 1912 conferred upon him the honorary degree of LL.D., an appreciation not only for what he had done while connected with the teaching staff of that University, but also as a testimonial of the great value of his continued researches.

He is a member of many scientific societies, including the American Society of Zoologists, of which he was secretary in 1890-93; the American Society of Naturalists, of which he was president in 1907; the American Association of Anatomists, of which he was president in 1908, and the American Philosophical Society; also he is a fellow of the Royal Society of Canada, of which he has been made a vice-president. Abroad he is a fellow of the Royal Microscopical Society and a corresponding member of the London Zoological Society.

It was not until the New York meeting in 1907 that Professor McMurrick joined the American Association and he then affiliated with the sections on zoology, and physiology and experimental medicine. Two years later came his promotion to fellowship, and in recent years his relationship has been with the newly-created section on medical sciences. At the meeting held in Toronto in December, 1921, it was wisely deemed best to elect a president who should be a citizen of the hospitable country where the Association met and so clearly indicate that science was universal. To select the foremost representative of the biological sciences in Canada proved an easy task, for the choice was promptly conceded to be J. Playfair McMurrick.



This year's president of the American Association for the Advancement of Science

Temperatures in the United States

IN a recent number of the *Monthly Weather Review* Professor Robert Ward discusses most interestingly the new temperature charts of the United States that are to appear ultimately in the *Atlas of American Agriculture* (U. S. Department of Agriculture).

Beginning with a broad, world-view of the trend of isotherms across the continents, the author shows how the great ocean currents crowd the isotherms in latitude on the east coasts and spread them apart on the west coasts. This accounts for the mild climate of the west coast of Europe as compared with the east coast of the United States. In middle and lower latitudes, the east and west coasts of the United States do not differ materially in mean annual temperature, but in northerly latitudes the mildness of the Pacific Coast asserts itself. In latitude 45 degrees N., for instance, the mean annual temperatures are about 10 degrees Fahrenheit higher on the west than on the east coast; while San Diego, Calif., and Charleston, S. C., in the same latitude, have approximately the same mean annual temperature.

A striking feature of the mid-winter chart is a southward curving of the isotherms over the northern interior districts, which emphasizes, among other things, the fact that the western border of the Great Plains and the eastern foothills of the Rocky Mountains are warmer in spite of their greater elevation than the lower-lying country farther east. Prevailing off-shore winds along the Atlantic and Gulf coasts prevent the full effect of the moderating influence of these warm waters from being realized. But, in spite of this, the isotherms bend in general accord with the coast lines. The moderating effects of water are also observed to leeward of the Great Lakes. Along the Pacific Coast, on-shore winds cause the isotherms to parallel the coast, thus affording an interesting comparison of the effect of prevailing winds and latitude controls, the Atlantic Coast being conspicuously subject to the latter.

Upon what does our judgment of an abnormally cold or warm month depend? Certainly, our senses are not capable of averaging a month's temperatures so that they can conclude that this month or that was abnormally warm or cool. Such opinions, it seems, are based upon extreme "spells" of weather, their severity, and their distribution.

What is the physical cause underlying the sequence of unusually mild or cold seasons? Such abnormalities have been noted since the earliest times and have been studied by Schott, Stockman, and Henry, and more recently by Dr. C. F. Brooks. The first three showed that no permanent change of temperature is taking place. Dr. Brooks has shown that no other than a chance relationship has existed during four-fifths of the years from 1812 to the present; the remaining fifth is represented by two series of alternating cold and warm winters attended by similar preliminary seasons. These series begin with 1872-73 and 1917-18, and are of especial interest in connection with their bearing upon generalized long-range forecasting.—*Abstract from article in Science for March 17, 1922.*

Automatic-Winding Clock

ONE of the pet problems of the inventor is the contriving of a device for the automatic winding of clocks. Some inventors have tackled this problem from the water-pressure standpoint and have evolved somewhat complicated mechanisms, wherein the clock is connected in some manner with the water-pipes in the house. Each time that the water faucet is opened and water is allowed to flow into the sink, the winding mechanism of the clock is actuated and the clock is wound. Such clocks can be hung on the walls, and the winding mechanism is of the ordinary weight and chain and sprocket wheel arrangement. The lifting of the weight serves to wind the clock, which is accomplished by the water pressure. After the weight has been lifted to its highest point and the clock is fully wound, then, when the water faucet is opened the next time, a special contrivance serves to disconnect the entire apparatus. When the weight begins to fall, the flow of water serves to lift it once again.

Other inventors have attempted to utilize the action of heat in the rays of the sun for this purpose. A radiate container of mercury, which is arranged on a shaft, is subjected to the action of the sun's rays at several points through the interposition of a lens, so that the mercury, which is enclosed in the container, is caused to expand. The star-shaped wheel is set in rotation by the aid of proper connecting devices through the change in the position of the center of gravity of the mercury container. The rotary motion of the star-wheel serves to wind up the spring of the winding mechanism. The automatic winding of clocks has also been effected through contrivances which are actuated by variations in air pressure or in the temperature of the atmosphere, mechanisms which are, however, too complicated for general use.

The newest thing in self-winding clocks, or rather watches, has just been introduced by an English manufacturer, and that is a self-winding wrist watch. This watch is wound up automatically by the movement of the ribbon, which fastens the watch to the wrist of the wearer, whereby the lengthening or shortening of this ribbon, as the watch is being fitted to the wrist, serves to wind it up. Another new development of self-winding mechanisms applies to wall clocks, wherein the mere opening and closing of the door serves to actuate this mechanism and wind the clock. Similarly, the winding mechanism may be connected with the cover of a desk or the drawer of a table or sideboard, whereat the opening or closing of these will automatically wind the clock. The automatic mechanism is claimed to be very simple and the connection between the door, or desk-cover or drawer is made by means of a fine invisible wire. Such an arrangement overcomes all the difficulties encountered with the complicated contrivances which have been used for this purpose heretofore.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

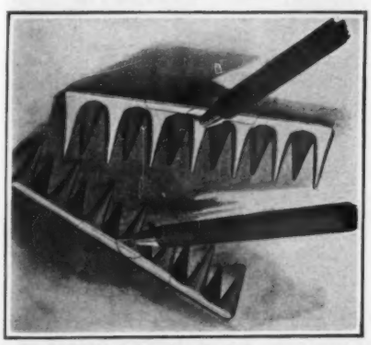
A better machine for taping armatures and field coils

Efficient Electrical Taping

MORE than once we have shown clever electrical apparatus developed by P. E. Chapman, of St. Louis; and now we give Mr. Chapman space again, in connection with his machine for taping armatures and field coils. This machine is directly belted to a very slow-speed motor on which is mounted a cone clutch, giving instantaneous and very fine speed adjustments. The continually moving member of the clutch is pinned to the armature shaft, which has enough end play to permit clutch disengagement. It is returned to open position by the magnetism of the motor, eliminating a thrust bearing and a spring. A combined self-oiling cone-driving pulley, brake pulley and clutch member rides on an extension of the motor bearing; this is active only when engaged, thus doing away with loose-pulley bearings. Pins are provided for handling the coils and for storing ten gross yards of tape. Ample clearance is had for leads and for various positions of the coils. The outfit may be operated from a light socket, making it possible to take it to any job.

The Non-Clogging Rake

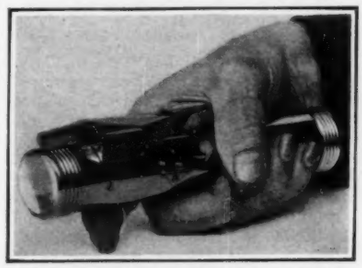
NOW it is the turn of the common garden rake to be improved by invention. Everybody who has ever used a comb rake knows how it clogs with stones, twigs, etc. The trouble seems to be that the teeth are too close together, but if they were any further apart the rake would not rake clean. James Ritchie of New York has resolved this apparently paradoxical demand into its components by producing a rake in which the teeth are in two rows. Those of either row are twice as far apart as custom has heretofore dictated; but those of the two rows are staggered, each into the spaces between the others, so that for the rake as a whole the teeth are spaced laterally just as before. It is claimed that this increased spacing, staggered arrangement, and the new bell shape made possible for the wider-set teeth, contribute to making it out of the question for clogging to occur. Obviously, too, this rake is more effective as a general gardening tool than its predecessor—harrowing and seeding being merely two of the operations which it suggests.



The staggered rake that does not get jammed with refuse

The Dustless Ash-Sifter

THE economical person whose conscience will not permit him to discard the ashes from the kitchen range without having first made certain that they contain no combustible material finds, sometimes, that his path is not strewn with roses. Mr. Lewis Shader, for instance, of North Bergen, N. J., was rudely interrupted in his ash-sifting by a peremptory demand from his landlord that he cease the production of dust for the benefit of the family in the apartment upstairs. Mr. Shader necessarily ceased, but the sight of good coal in his ashes set him to work on the invention of a dustless ash-sifter. Not a less-dusty one, or a relatively unobjectionable one, but an absolutely guaranteed dustless one. Our photograph shows the results of his work. The chief trick is



The flashlight revolver for steadying the inexpert aim

the provision of a hole in the bottom of the case—a hole that just fits the hole in the stove top, where the lid goes. Sifting can be done only when there is a good, healthy fire in the range—not when the fire is banked, even, but when it is actually burning like a real fire. The lid is removed and the sifter put in its place. Sifting goes ahead in the customary fashion—but the dust is drawn up the chimney by the draft, and no vagrant particle of it escapes this fate. Mr. Shader's upstairs neighbor has put his official acceptance upon the device, which is now in daily use in the Shader kitchen.

An Adjustable Wrench Without Screws or Springs

PERPETUAL motion was once the goal of every inventor. As this subject became more clearly and more generally understood, its universal popularity faded, and the test for charter membership in the inventive brotherhood came rather to revolve about whether the applicant had ever patented a lock-nut or a non-refillable bottle. Today the lock-nut problem has been fairly well met by the lock washer, and we aren't as interested in whether our bottles are refillable as we used to be. But we have with us today the wrench problem; and now it appears that nobody is a real inventor unless he has designed a wrench that will take instant hold of a nut of any size or shape, in any position, maintain the bull-dog grip until it is time to let go, and then let go sweetly. Examination of our issues of the immediate past will show that right in this department, we have not for some months been complete without at least one such wrench.

This month's candidate is an end-

Sifting ashes is made a clean job by this sifter

wrench without any adjusting screw. The handle member forms the lower jaw and is notched at right angles to the gripping face, while the movable upper jaw is also notched and can be moved up or down when the notches are pulled out of engagement. Simply by pressure from the thumb of the hand holding the wrench the jaw is disengaged and moved up or down without friction to the desired adjustment; and this action, it is claimed, makes disengagement as easy as engagement.

The Flashlight Revolver

PROMINENT among the devices by means of which the comic artist fixes our attention upon his point is the dotted line which indicates the path of the eye, of the thrown missile, etc. Now comes somewhat the same idea in cold, hard practice. The reason why so many of us find it difficult or impossible to shoot an ordinary revolver with any certainty of hitting the objective is that the sighting process is not automatic, as it largely is with the longer-barrelled rifle; the man behind the pistol has to draw, mentally, a dotted line representing the intended course of the bullet, and in his excitement or inexperience he does not draw it in the right place. A Buffalo inventor, S. P. Cottrell, comes to the rescue with a combination of flashlight and revolver, so mounted on a common axis that where the flashlight hits the gun will also hit. The light and the revolver elements are separately operated by triggers of the usual construction, conveniently placed on opposite sides of the flashlight barrel. The apparatus is no toy, but is of thoroughly workmanlike design; it is a perfectly good gun and a perfectly good flashlight, and as a means both of illuminating the object shot at and "drawing a bead" thereon it seems an altogether admirable

Adjustable wrench with no moving parts save the jaws themselves

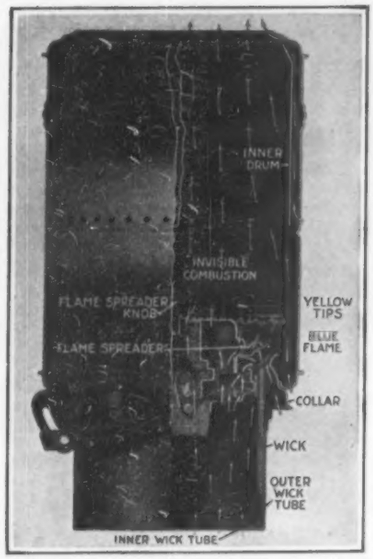
combination. With its use it is apparent that anybody with one good eye ought to be able to hit a target ten times out of ten attempts; so it is given to hope that more bullets may hereafter find the fleeing burglar, and less be sprayed over the surrounding landscape.

A Milk Alarm Bell

IF statistics could be collected it would probably be found that the quantity of milk lost, spoiled and burned by allowing it to boil over would amount to a serious percentage of the total supply of one of the most valuable of all foods. For the "lactabell" it is claimed that it will save much waste wherever it is used.

The instrument comprises an ordinary bell gong fitted at the top of a tube containing a fusible composition that melts at a temperature equal to the scalding point of milk, or about 154 degrees Fahrenheit. This composition consists of an alloy of bismuth, lead, tin and cadmium in the proportion of about 50, 24, 14 and 12 parts. The striker is fitted on the end of a lever on which a pawl is also fitted. In the top of the tube is a small shaft on which a ratchet wheel is mounted. When the instrument is not in use, the fusible composition is in a hard condition and binds the ratchet wheel shaft so that the wheel cannot turn. To set the bell the striker lever is moved until the pawl engages the ratchet wheel. The tube is then placed in a saucepan containing cold milk, being hung on the inside of the rim by means of a pair of hooks, and the saucepan is then placed on the fire or over a gas jet. As soon as the

The alarm bell that rings when the milk is about to burn



The working scheme of one of the successful kerosene-burning cook-stoves

milk reaches scalding point the fusible composition softens and allows the ratchet wheel to move. A strong spring then draws the striker, causing it to strike the gong sharply and warn the cook to remove the saucepan.

A New Fire Grate

THE accompanying pictures illustrate a new form of grate invented by Mr. H. B. Clappé of London. The object is that, instead of a coal fire presenting a dark surface towards a room for a considerable proportion of the time it burns, it shall present a white hot surface, by which means greater heat is radiated into the room for a given consumption of coal, resulting in a considerable economy in fuel, and giving a much brighter effect than an ordinary fire.

It would perhaps be more strictly accurate to describe it as a set of firebars, since it can be used in any existing grate. The set of bars, which are spaced at suitable distances apart for letting the coal through, and which slope downward from front to back, is placed in the empty grate. Coal is piled above and around them, and paper and sticks are placed in the hollow space and lit. The coal quickly ignites and very soon the whole of the hollow space presents a white hot surface. So great is the heat that if a kettle of water be placed in front of the bars, the water will soon boil, while bread can be toasted, a chop or steak can be grilled or vegetables boiled with ease. The grate should also prove of value for laboratory work.

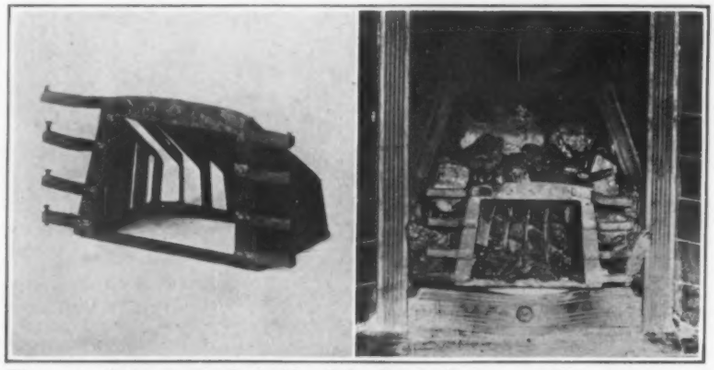
Cooking with Oil

AMONG the oil-stove burners for cooking which we have tried and found satisfactory is the one illustrated on this page. The drawing shows its manner of operation. The largest quantity of air is taken in through the wick tube. This cold air, indicated by the white arrows below the flame spreader, passes through the latter member, mixes with the gases vaporized from the oil, and this mixture burns. Combustion takes place in three stages, as indicated by the colors of the flame: blue, yellow and an almost invisible haze above the latter. Most of the heat from this flame would be lost in radiation were it not for the introduction of a cool stream of air taken in through perforations around the bottom of the drum, just above the extreme flame tips. The object of the stove, of course, is to carry all possible heat clear up to the top of the "chimney" and there deliver it against the surface of the pot or pan; and any radiation from the sides of the chimney is a dead loss. This cool blanket all around the drum prevents radiation. Midway up the chimney (of the stove again, of course, not of the house) this draught becomes heated. At this point another series of perforations permits another air current to enter, and a drum, placed within the outer drum, forms a hollow wall through which this second cool-air volume passes. This second stop again saves much heat that would otherwise be lost in radiation. In so doing, the air within this hollow wall becomes heated, but even this heat is not lost, for it is thrown in with the main volume of heat coming from the top of the chimney and impinging upon the bottom of the kettle, frying-pan, or whatever vessel be over the fire.

Something new in paper clips

A Paper Clip of Greater Utility

PAPER clips are available in a wide variety, but most of them are either too big or not big enough, or else too strong or not strong enough. The one we illustrate might at first glance seem open to the indictment that it is altogether too big; but its ready attachment and detachment, and its all-around service, will probably reverse this verdict after a short period of use. As one example of this general utility, the manufacturer's circular presents the appearance of a typical desk in a room where windows are open, fans going, etc. Scissors, ink-wells and the tops thereto, calendars and date-stamps, seal-presses and paste-pots, and the inevitable telephone, are all shown doing duty holding down piles of papers or individual documents. Everybody knows that this system fails at the point where it becomes necessary to use any of the documents, or any of the accessories which have been set on them to hold them down. One of the clips illustrated, however, grips sufficiently well to stay put on a single sheet of paper yet is sufficiently flexible to hold quite a sheaf; and it is heavy enough to withstand the blasts of the fan. When used to classify the papers in a filled brief-case it doesn't catch into the top sheets of other groups the way ordinary wire clips do. Incidentally, it is pointed out that the way to apply the clip is as pictured, placing it with the right hand at the point where the left compresses the sheets to be clipped. And it is stated that everybody who uses the clip discovers, spontaneously, a new use for it.



The grate that presents the inside of the fire to the room, and the appearance of the fire after the kindling has burned out

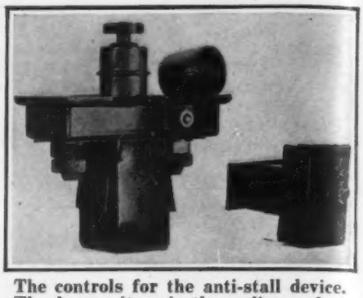
The Car That Will Not Stall

MORE than a few of our automobile disasters arise from the accidental stalling of our engines. It is very easy indeed, when taking a rough railroad crossing at cautious pace with engine closely throttled, or when running in heavy traffic with just enough gas to keep it alive, for the roadway or the driver to make a sudden demand for more power—a demand which cannot be met with the small amount of gas which the engine is getting. The resulting stall is always embarrassing at the very least; and it always brings within the realm of possibility a crash from behind or from the side.

A very clever anti-stall device is being put on the market in New York. The starting motor is connected into the ignition switch in such a manner that the act of switching on the ignition switches on the starter as well. This has been done in the past, of course; a cut-out being supplied to put the starter out of action as soon as it has done its duty. But these cut-outs have been regulated solely by engine speed, and have had to be set for the speed after which the starting engine is certain to remain started, rather than for a zero speed. The result has been that when the engine idles or is closely throttled, the starter comes into play and drains off the life-blood of the battery.

The present cut-out is constructed somewhat differently, and does not act until the engine comes to a dead stop. When this occurs, however, it acts instantaneously; and the engine presumably being warm, it comes right out of its stall. One's hasty impression might be that it would be impossible to stop at all; but this, of course, is not the case. Switching off the ignition cuts off the spark, and cuts off the starter also, so that the anti-stall device does not come into play.

A master switch is provided in addition to the regular ignition switch. If for any reason it is desired to run the car with the anti-stall device inoperative, this switch is opened. The ignition circuit remains undisturbed, and the starter will work when the starting pedal is depressed in the usual way; but the ignition and starting circuits have lost their connection, and the car runs in the ordinary way, just as though the anti-stall device were not present. It will be possible, for instance, to explore for trouble by spinning the engine with the starter.



The controls for the anti-stall device. The larger item is the ordinary foot starting-button with the necessary added attachments; the smaller one at the right is the master switch for the instrument board

It is pointed out that there is really no good reason why one should have to close two electrical circuits to start the engine. Separate switches for ignition and for starting motor are a relic of the day when the starter was a new and novel attachment, superposed upon the car and not an integral part thereof. Incidentally, the device makes it impossible to leave the ignition current flowing and exhausting the battery; for one can stop the engine only by turning off the spark, and if one then kick the ignition switch over accidentally, the engine will at once start and attract one's attention.

Eye Glasses That Do Not Disfigure

THE handsome gentleman in spectacles whose portrait adorns the southeast corner of the page is really no more beautiful than you or I. The only difference is that the aids to vision which he wears are specially designed to improve his appearance, while those which you and I affect have been got up from the standpoint of utility alone. The difference, to be specific, isn't very great, but it is very decisive. The top edge of the glass has been heavily blacked, so that the lenses blend with the line of the eyebrows and accentuate that line. In addition, the clean-cut upper edge of the glass, which is perhaps the most disfiguring feature of the ordinary spectacles, is concealed by this treatment, and the result is a more harmonious combination of face and glass. The scheme is developed by Dr. F. G. Murphy of Mason City, Iowa.

Spectacles that accentuate instead of concealing the curve of the eyebrow

Paring knife with guard for the finger

Growth of Federal-Aid Roads

MORE than 1000 miles a month has been the rate of growth of completed Federal-aid roads during the present working season, says the Bureau of Public Roads, United States Department of Agriculture. The mileage completed on August 31 totaled 19,308, of which 6401 miles have been added since the beginning of the year. On the same date there was under construction 14,670 miles. Federal-aid roads in all stages, from approved projects to completed roads, now total 41,405 miles, or 23 per cent of the system of highways being outlined by State and Federal engineers.

Testing Armatures

BUILDERS of armatures will be interested in the testing instrument illustrated herewith. It gives simultaneous and instantaneous indication of the condition of each section and of the completed armature as regards open circuits, bad joints on coarse windings, short circuits between sections, short-circuited windings, mixed connections, irregular number of turns, grounds, etc. In each case the location of the trouble is revealed as well as its nature. The tests are made at substantial voltages, rather than at micro-potentials. It is claimed that an entire armature is tested for all its possible defects in less than the time taken by a millivoltmeter reading of one section. Because instrument needles are slow and hard to read, a circle of small lamps is used for each armature section and an additional circle for ground. These indicators burn as with half voltage for normal armatures; on short-circuits they flash up brightly; on open circuits they extinguish; for bad joints and excess turns they burn dim; for other indications they display further irregularities. The life of the lamps is very long, since they are lit only when an armature is being tested, and then (assuming no defects are present) only at half voltage. The outfit is a production instrument only; it has to be designed especially, as regards size, etc., for the armatures on which it is to be employed, and it is not then adjustable for other use.

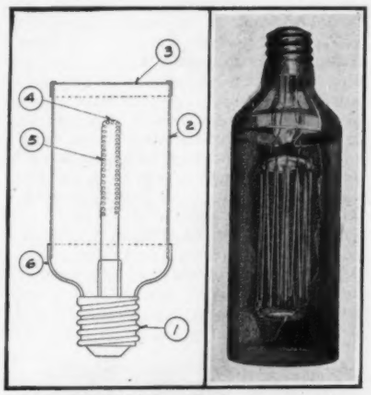
The armature meter that gives a complete production test of the armature and each section thereof, in a single operation

Easy on the Fingers

AN improved paring knife provides a guard and a rest for the finger. It makes using a knife of this kind for a considerable time an easy matter, whereas with the straight, unprotected back as on old knives the first finger became blistered at times.

Burning Explosive Gas to Prevent the Explosion

THE accumulation of explosive gas mixtures in enclosed spaces is of frequent occurrence, and accidental ignition of these mixtures in public places has led to disastrous results. Thus the explosion of sewer gases in city sewer systems is not at all infrequent. So, too,



Open electric lamp for burning explosive gases before they reach the explosion point

occasional explosions are reported from public-service tunnels and underground systems. The same problem presents itself as a result of gas mixtures which accumulate from various causes in closed vaults containing control apparatus, electrical and otherwise, in transformers and similar apparatus.

When such accumulations occur in mines or other large spaces of the sort, little can be done beyond securing the best possible ventilation. In more limited spaces, however, the Westinghouse Research Laboratory has demonstrated that it is feasible to remove the danger of explosion by burning the explosive mixture as it accumulates. In order to do this, of course, the gas must be oxidized at a temperature considerably below that at which the explosive wave is propagated. It has been possible to do this by the use of an oxidative catalyst finely distributed over a porous surface. This is done by means of an electric resistance member, operating much like the electric lamp, save that it is open to the atmosphere and does not develop extreme temperatures.

In the diagram, (1) is a lamp base of the ordinary type which may be screwed into any ordinary lamp socket for the purpose of making connection with 110-volt current sources. The leads are brought in from this base in standard fashion through a glass insulating member. The fine-mesh wire screen (2), (3) makes the outfit function like a Davy safety lamp—a precaution which experience suggests is hardly necessary but which is nevertheless taken. This screen is supported by the glass member (6). The filament itself, (4) and (5), may be a coat, or (better) a solid porous cylinder internally heated, or a group of wires sheathed in porous tubes and arranged in the form of a hollow cylinder. These arrangements provide better for the presence of the catalyst than the ordinary filament forms.

When actively functioning in an explosive atmosphere, the temperature of the filament is somewhat higher than that produced by mere passage of the current. This is, of course, the result of the heat of reaction. This increase is readily discernible in terms of the filament color; and the temperature drops again when the combustible gas is exhausted. This gives an admirable qualitative indication of the presence of explosive vapors.

Japanese Automobile Design

A NEW automobile of Japanese production known as the "Midget" was recently placed on the market in Japan. The car is built to meet the peculiar conditions of that country, taking into consideration poor roads, narrow streets, high price of fuel and limited buying power of the public. The car, which is very small, has a wheel base of only 84 inches. The total weight of the car is only about 850 pounds. The top of the door is 37½ inches from the ground. The engine is an air-cooled V-twin, developing 12 horsepower. Cooling is aided by a belt-driven fan, placed directly in front of the engine behind the false radiator. The transmission is selective, with three forward speeds and one reverse. The transmission case is mounted far enough behind the engine to allow for a transmission brake between the two units.

The Vest-Pocket Gas-Mask

GAS-MASKS are such an old story that to get past the ennuied editor they must possess features of real distinction. That the latest production of the Bureau of Mines qualifies there can be, we think, little question. It is a vest-pocket canister containing an absorbent mixture of activated charcoal and soda lime with filters of Turkish toweling, capable of removing from the air that passes through it any of the gases ordinarily encountered in the experience of firemen and engineers in tunnels. It is clipped to the nose with a clothes-pin-like clasp which in the bargain assists the wearer to breathe through his mouth, and for short periods affords good protection.

Gas-mask of novel design for use in tunnels, etc.

Where the Better Way is Cheaper

A NUMBER of car manufacturers have adopted a new method of fastening down automobiles for shipment by rail from factory to dealer. By using steel loading blocks, instead of the wooden equipment formerly employed for this service, these manufacturers have reduced loading and unloading time and costs considerably, and at the same time have made their cars even more secure from possible damage while in transit. The blocks are returned by the distributor or dealer and used over and over again indefinitely.

In test, a car of automobiles anchored with these blocks was kicked against a string of 13 empty box cars with all brakes set at a speed of 25 miles an hour. The couple draft timber and the whole end of one box car were broken

Improved shipping-block for holding automobiles in place in freight cars

by the terrific impact, but the blocks held the automobiles securely and without the slightest damage.

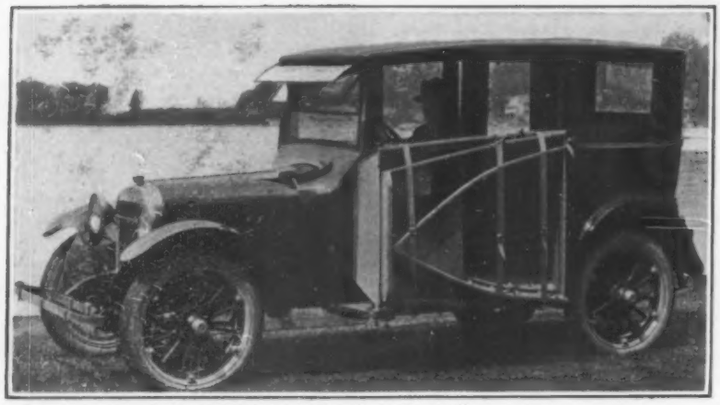
The blocks are 10½ inches high and stamped from blue annealed, pickled, oiled and limed stock. They weigh 10 pounds each and can be nested and returned to the factory by the car dealer in bundles of four or more by fourth-class rating. They average one and one-half trips a month at an average return cost of 40 cents per set of eight. Each is stamped with the automobile manufacturer's name to prevent loss in transit.

Tabulated figures show that the steel blocks earn their cost in five trips. Many letters from dealers express approval of the new method because of the time saved in unloading and the fact that the steel blocks prevent chafing of tires. Railroads have endorsed the method from a claim-prevention standpoint. The blocks also do away with most of the damage to freight car floors, as an easily removable double-head nail is used.

Renewable Indicating Fuse

THERE is but one positive method for locating blown fuses and which is generally employed by everyone. It is by means of a test lamp. The leads are shunted around each fuse in turn until the test lamp indicates an open circuit. Since the test lamp has proved such a general and efficient fuse indicator it has been incorporated in the design of an indicating and easily renewable fuse. There are but three parts in this device, the pilot lamp, the fuse element holder and the shell. The shell forms the socket for the pilot lamp and combines the whole into one compact unit. As may be seen from the illustration the lamp is in parallel with the fuse element. Upon the rupture of the fuse element the circuit is then through the lamp. A supply of new fuse material is made available on a bobbin attached to the fuse. No tools are required in renewing the fuse element. These features should

A new type of indicating fuse to take the place of exploring with a lamp in the search for a burned fuse



A portable boat for the automobile camper

prove very attractive to those who have experienced trouble and delay in locating and renewing their fuses.

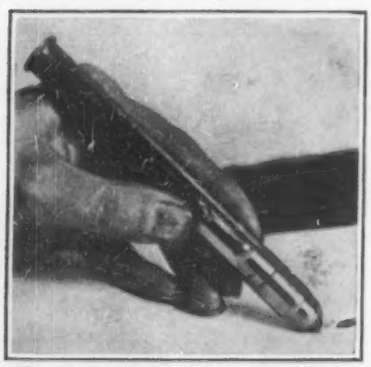
A New Toothbrush Every Day

WHO has not found himself minus a toothbrush, in a place where no toothbrush was to be had, and filled the gap in his toilet by vigorous use of a wad of cotton batting? There is more to be said for this expedient than appears on the surface. No atmosphere is very sterile, and it is difficult to have much confidence in the scrupulous cleanliness of the ordinary toothbrush, standing or hanging all day in the open atmosphere of the bathroom. Why not, with the inventor of the device shown, have a brand new brush each day? A fresh wad of absorbent cotton gripped in the elegant little ivory pincers may not have quite so searching an action as the bristle brush; but as suggested it has its points of advantage.

A Fountain Pen for Paste

THE paste-pot is an awful nuisance—nobody knows it better than the editor. When it is not bone dry it is too full of water; or if by any chance the paste emulsion is in just the ideal state of moisture, then the brush is missing. And it's a frightfully mussy thing to have around, in the bargain.

The answer—or at any event an answer—is the glue container shown herewith. It fits the pocket like a fountain pen. When a slight pressure is exerted on a ball at the end of the barrel, enough glue flows from the business end to glue the flap of an envelope or the corners of a photograph. If this is enough for the job in hand, there is no excess glue to gum up the whole neighborhood; if it is not, another squeeze brings some more. Not the least advantage is its transportability—one can always have it with one, in places where one would hardly have had the foresight to carry a paste-pot, or been able to do so.



The pocket glue-pot that works like a fountain pen

For the Water-Loving Automobilist

AUTOMOBILE camping outfits have been offered in such variety that one would suppose all the possibilities had been covered; but we illustrate a combination which comes to our attention now for the first time—that of automobile and portable boat. The marine member of this partnership is made in three sections, divided by water-tight bulkheads. Each section is in fact, apart from its unconventional shape, a perfect boat in itself. The lines of the assembled craft are such that, when disassembled, the bow section will fit neatly in the stern member, and the latter in the central piece. In this way the demounted boat can be nested for carrying on the running board, as shown in our illustration. The boat is of steel, and comes in various sizes; but all sizes are light enough to enable one man to handle them without difficulty.

Standard Cells of Low Voltage

IN the issue for November, 1921, of the Proceedings of the Physico-Mathematical Society of Japan, Mr. J. Obata describes the investigation he has carried out on the possibility of constructing standard cells of low voltage for testing purposes. Nine types of cell have been studied, in all of which cadmium or cadmium amalgam formed the negative, and cadmium or lead amalgam the positive pole. The electrolytes were solutions of lead or cadmium sulfate, chloride, bromide, or iodide, and the cells were given the H form. The two cells which proved most suitable for standards were the cadmium and lead cell with an electromotive force at 20 degrees Centigrade of 0.09838 volt and a temperature coefficient of 0.00024 volt per degree; and a cadmium cell with an electromotive force of about 0.01 volt and a temperature coefficient of about 0.0004, according to the strength of the dilute amalgam.

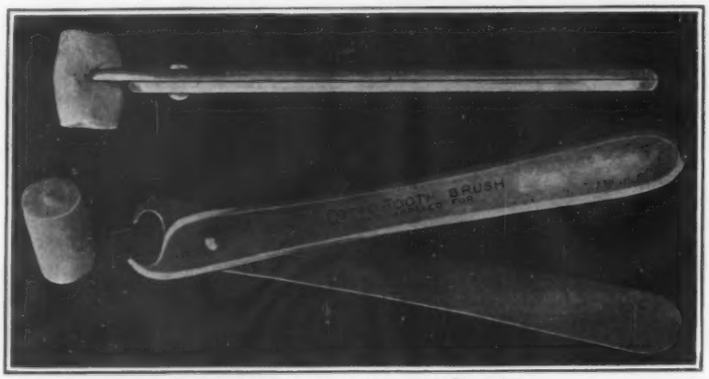
Room Heater and Toaster in One

HERE is the latest design in room heaters for these mornings when apartment dwellers must furnish their own heat or go without. As it stands it is resting on its handles. In this position delicious toast can be made at the same time it is heating a room. It is portable, being easily carried about by its two handles which also serve as feet.

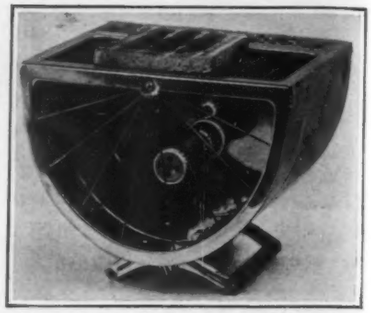
An Experiment with Gliding Boats

THE Argentine Minister of Public Works has approved the purchase by the Department of Navigation and Ports of five hydroplanes, or gliding boats, which are to be used as an experiment on the River Bermejo, one of the big inland streams in the north of this republic. Public bids for more of these machines are also being invited with the idea that if the experiment proves successful this system will be widely employed on the many streams in Argentina in the solution of the problem of rapid communication between important inland cities and towns, of which Argentine has many prosperous and rapidly-growing examples.

At present the passenger, mail and cargo services on the many big rivers which are navigable for hundreds of miles from the coast are best described as primitive. Between Buenos Aires and towns on the Parana River fairly large craft are utilized, though they are slow. Off the main traffic routes, where there are still important points to be served, mails, cargo and passengers are transported by antique steamers that commonly enough have not sufficient power to stem the strong currents, or when loaded pile themselves up on the sand bars. Not so long ago one of these relics of a by-gone age of navigation took fire and blew up, about 80 lives being lost. For want of more efficient means of transport parts of the republic that otherwise would be thickly populated and productive are almost undeveloped.



The latest note in sanitary toothbrushes

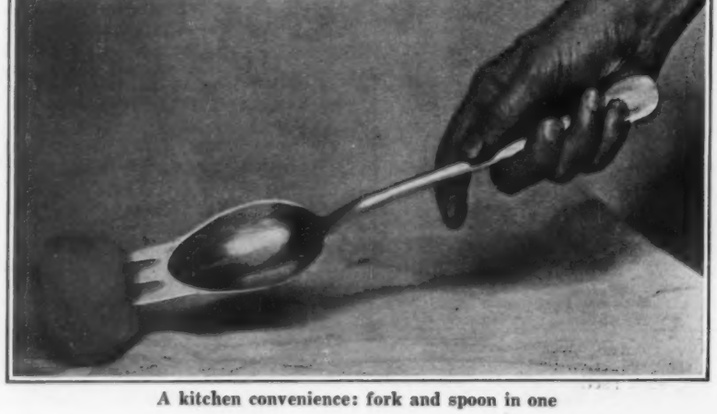


Room heater that presents a level top for making toast

The gliding boats already purchased by the Government are to be put into service between the ports of Presidente Roca and Bermejo. The distance is roughly 200 miles, and the steamers at present used take 15 days for the round trip. With the gliders it is hoped to makes the one-way trip in a little over six hours. The first four machines contracted for are Neuport-Macchi type, constructed by the famous Italian firm of Ansaldo. Each has engines of 300 horsepower, driving an aerial propeller, which gives the loaded boat a speed of 60 kilometers an hour. These machines have accommodation for eight passengers, pilot and mechanic, and will carry over a ton of cargo. The fifth glider is being supplied by the French firm of Galvin. Boats and mechanics for assembling them in Argentina are now on the way from Europe, and it is expected the service will be in operation at the end of October. It is officially announced that the Italian machines cost approximately $9,000 each.

Two Table Tools in One

THE Patent Office may insist that mere combination of old elements to produce no new result is not invention; but the inventor goes merrily on, giving us two or three familiar tools in one, just the same. Usually these are tools of the sort one would expect to find in the mechanic's kit; but occasionally they invade other fields, as the one we illustrate—a fork and spoon in one. We have seen combination knives and forks, but the present partnership is new to us. Perhaps it will be used for peas, puddings, and the numerous other edibles that leave one in doubt between etiquette and the fork, or convenience and the spoon. One might even attack onion soup with some assurance, thus armed. Candor compels the admission that the example displayed to us was of aluminum, for kitchen use alone; but we have no doubt it will appear in more elegant materials and for more elegant uses.



A kitchen convenience: fork and spoon in one

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Bean "Boards"

THIS is the name given to a new product, which is made in Darien, China. It is used for feeding animals and is chiefly exported to America. The "boards" are rectangular in shape, measuring 28 by 12 inches with a thickness of eight-tenths of an inch. By submitting them to higher pressure than is applied in the case of bean cake, they are made to contain less moisture, which renders them less liable to become moldy in transit.

Improvements in Clay Piping

THE use of clay piping in the place of the more expensive cast iron pipes has always been looked upon with much favor, but the great difficulty has been in joining lengths of clay piping together so that they will not leak. This problem has been solved in the Carnegie Institute of Technology in Pittsburgh and an entirely new jointing practice and technique have been developed. Exhaustive tests have proven the worth of the new method. Bituminous cements are used for this purpose. It has been established that a proper bituminous compound can be used efficiently for joining clay piping; that joints made in this manner will withstand any pressure that the pipe itself will stand without showing a leak; that the pipe line can be thrown out of alinement without causing a leak at the joints; that leaks due to poor workmanship can be easily and quickly repaired.

Gas Made From Crude Lignite Coal

CRUDE lignite coal, in the condition in which it is dug out of the ground containing as much as 50 to 60 per cent of water as well as considerable mineral matter, can be converted directly into gas in a special gas producer, provided with a star-shaped rotating grate. The description of the apparatus and of a complete installation, such as is used quite extensively in the steel plants in West Germany, are given in *Chemiker Zeitung*, July 13, 1922. Not only is gas made from this raw material, but tarry products are recovered as well. Steam is passed through the generator as the gas is being made. The calorific power of the gas is about 1,250 calories in the dry condition. The entire plant consists of a producer, pre-cooler, centrifugal washer, percussion separator and final cooler. The gas is first cooled and then its tarry contents are removed in the centrifugal washer. The last traces of mechanically held tar are removed in the percussion separator. The water vapor in the gas is finally condensed in the last cooler. A number of operating advantages are gained by the use of this installation. If the efficiency of the gas producer is assumed to be 70 per cent then 140 tons of crude lignite coal, possessing a heating value of 2,300 calories, will be handled daily in a four-producer installation. About 1.4 cubic meters of gas, having a calorific value of 1,150 calories, can be obtained from one kilogram of coal.

Wood Colored As It Grows

A REPORT from Dresden intimates that a German engineer has succeeded in coloring wood as it grows. Living trees are given any desirable color by this process. It has been found that a whole tree from the end of its roots to the topmost leaf can be completely and permanently colored within forty-eight hours after application of the dyes. An aniline dye is used and 50 grams of the coloring matter together with 200 liters of water are sufficient for one tree. The process has been patented and it is understood will be put to practical use at once. Furniture, cigarette cases, pen-holders and other articles are to be put out on the market, all made from the new colored wood. The process affords an excellent means of imitating certain natural woods.

Kerogen From Oil Shale

THE United States Bureau of Mines at Boulder, Colorado, has announced that it has successfully separated kerogen from Utah and Scottish shale in addition to standard Colorado shale. The results will be published shortly. All difficulties have been overcome except that due to the difficulty of distributing the nitrogen.

Fat Splitting Agent From Naphtha

THE various sulfonated derivatives of naphthalene are used as fat-splitting agents. It has been found that the presence of other substances, such as turkey red oil, is necessary for the fat-splitting agents to exert their action. The sulfonated derivatives of various fractions of crude oil were also found to be effective for this purpose.—*Chemische Umschau*, 1922, No. 32, page 255.

New Method of Making Sulfuric Acid

AN improvement over the old chamber process of making sulfuric acid has been developed in South Africa. Instead of using large lead chambers the inventor substitutes a small horizontal cylinder, which is provided with a number of perforated plates. The hot gases, from the sulfur burners, pass into a Glover tower, where they are cooled down to a temperature of about 80 degrees C. and at the same time washed with acid of 66 to 78 per cent strength. Then the gases mixed with water vapor are introduced into the horizontal cylinder at the bottom, while nitroso-sulfuric acid is passing through the same apparatus. In this manner the acid is freed of its nitrogen content, while the sulfur dioxide is converted into sulfuric acid. The evolved nitrogen oxide gases are absorbed again in two Gay-Lussac towers, connected in series, and returned to the process for further utilization.—*Chemiker Zeitung*, 1922, page 699.

Concrete Gas Producer

THE latest development in the gas industry is the concrete gas-producer, an apparatus which was developed by Italian technologists. This apparatus is well suited for use in gas plants and large steel plants, which make their own gas. The body of the apparatus is shaped in the form of a bell and is made from reinforced concrete. The base of the producer is concrete as well and the producer is set into a shallow vessel filled with water, which makes a water seal. The apparatus has been tested to determine its resistance to explosion, an important structural feature of gas producers, due to the fact that accidental explosion of the gas produced can take place at any time, and it has been found to be absolutely explosion-proof. The producer works very efficiently and is being used in a number of installations in Europe. Its particular attraction to gas makers is the low cost of the initial installation as well as of subsequent upkeep and repair. It is claimed that the cost of the apparatus is less than 50 per cent of that of the all-steel producer of ordinary practice.

Tannic Acid from Doga Bark

THE Doga tree grows in the mangrove swamps on the foreshores, all around the Fiji Islands. The wood of this tree is rich in tannins. It is reported that a company has been organized to undertake the manufacture of tannic acid from the wood. The tree grows to fair size and the yield of tannic acid is high enough to make the process practical commercially.

New Potash Fertilizer

A NEW form of potash fertilizer has been put out on the market in Sweden. It is known as "Electrokali." The fertilizer is made from the slag recovered from the electric furnace manufacture of ferro-silicon from feldspar and iron turnings. The slag is finely ground and mixed with other ingredients to give a fertilizer which is rich in potash.

Liquefied Methane—A New Commercial Product

METHANE is the principal constituent of natural gas; it is the gas that emanates from marshes and confers upon them their distinctive odor. It has, of course, found use in the form of natural gas, mixed with other constituents in various ways, for example, as a fuel, in the manufacture of carbon black, etc., but up to the present time it has not been used commercially in the pure form. At the present time a plant is making and shipping liquefied methane in Germany. It appears that there are many advantages to be gained from the use of liquefied methane in comparison with the other gases that are commonly used for welding purposes. The oxy-methane flame is admirably suited for welding copper, brass and aluminum, the oxygen flame of the gas being milder and softer than that of any other welding gas. Methane is also being used on an ever-increasing scale for the autogeneous cutting of iron. The liquefied methane is kept in ordinary steel cylinders under a pressure of 150 atmospheres, and it is fed from these cylinders to the oxy-methane torch through the usual reduction valves. The new process appears to be working considerable inroads upon the more orthodox welding, at least in Germany.

Waterproof Cement

A WATERPROOF cement, which gives very good results when used in the building of walls, floors and other parts of structures, which have to resist the passage of moisture, is made from a mixture of chloride of zinc or sal ammoniac and chloride of magnesium. To this mixture zinc oxide or magnesia is added with the resulting formation of oxychlorides. After reaction has taken place, powdered glass or silica is added. The sal ammoniac in the cement retards the setting of the same. The cement can be applied with a brush or a trowel, and after application on coming in contact with water, it continues to harden and to become more resistant to water. The cement is made and used in Italy, and has not as yet been introduced into any other country.

Disinfectant Soap

DISINFECTANT soaps, made with corrosive sublimate or carbolic acid, have always been found to give considerable trouble in their application. The first class of disinfectant always presents the danger of decomposition of the disinfectant ingredient on coming in contact with water. Carbolic acid soaps have not proven to be very effective. A new Austrian invention uses lactate of silver as the disinfectant ingredient of soaps. Only a small amount of the lactate need be used. Such soaps have been found to be very effective for all purposes where a disinfectant soap is required. They are not corrosive and hence can be used to good advantage to sterilize all kinds of surgical instruments, as well as the hands, rubber gloves, etc. The silver lactate solution is made by dissolving one part of the salt in 15 parts of water, and then adding enough agar-agar or carragen moss to convert the liquid into a fairly stiff jelly. This jelly can then be mixed with the soap batch in the mixer and worked up into a finished product. The disinfectant silver lactate soap can be used in three forms, either in the solid, paste or liquid state. The manufacture of these different soaps is the same as that of ordinary soap. The solid soap is well-suited both for laundry and toilet uses. The paste form can be used in making dental creams wherein the disinfecting properties of the lactate of silver are of considerable advantage. The liquid form of the soap is well-suited for use as a gargle or mouth wash. The soap can also be made into a weak solution and sprayed into the air of rooms, stables, etc., its germicidal properties being well in evidence in this form.

Separation of Minerals by Decrepitation

CRYSTALS that contain water will disintegrate into a powder; that is, decrepitate, when heated. The water within them is changed into steam and the latter bursts the enclosing bonds that hold it in the interior of the crystal, causing the latter to disintegrate with violent force. Advantage is taken of this phenomenon in the separation of minerals whose specific gravities are too close together to permit of their separation by washing with water. A good example is a mixture of zinc blende and barytes, which minerals are often found associated in zinc ores. The process is very simple and consists in merely heating the mixture of the minerals in a revolving or reverberatory furnace to a temperature of 200 degrees Centigrade. This heat serves to convert the water of crystallization in the barytes into steam with resulting explosive disintegration of the crystals. The powdery mass is then screened out, leaving pure zinc blende behind in a form unaffected by this moderate degree of heat.

The Heavens in December, 1922

Where the Field of the Astronomer Overlaps Those of the Photographer and of the Physicist

By Professor Henry Norris Russell, Ph.D.

THE PAST month though doubtless an eventful one as regards astronomical observation has not been noteworthy for published discoveries. We know that some, at least, of the parties which observed the total eclipse had favorable weather—including the Lick Observatory party on the northwest coast of Australia. When their photographs have been measured and the calculations completed, the world will probably be in possession of decisive evidence, beyond the possibility of cavil, regarding the deflection of rays of light which pass near the sun. But these measurements and calculations are laborious, and it will probably be some time yet before we hear of their results. Meanwhile, we may return to the story of the recent meeting of the Astronomical Society, which was left unfinished last month.

A group of interesting papers came from the Research Laboratory of the Eastman Company. One of these gives a new answer to the old puzzle: Why do some grains of silver bromide in an emulsion become developable when the plate has been under-exposed, though the majority do not? It appears now that this happens because light consists of a rain of separate *quanta*, or bundles of energy, each emitted from a separate atom of the luminous mass. When one of these quanta hits a bromide grain, the latter becomes developable. Various aspects of this theory were discussed by Dr. Mees, Director of the Laboratory, in an article in the SCIENTIFIC AMERICAN for last May, under the title "Darts of Light," so that only one need be mentioned here. The amount of light which makes a single grain developable is apparently the smallest amount of energy which can get into the form of light—namely, a single quantum. This leaves no great hope of making plates which shall be very much faster than the existing varieties—unless indeed some one finds out how to make an emulsion with bigger grains, which make a blacker negative when the same number develop.

Things are different when we deal with red or yellow light, which does not act upon the silver bromide at all unless the film is treated with some dye which is able, as it were, to catch the quanta of slowly vibrating light and put them to use. Here greater speed is steadily being secured by the use of new dyes. One which has recently been tried, known as cryptocyanin, makes plates so sensitive to the extreme red (at the very end of the visible spectrum, near Fraunhofer's A line) that photographs of a landscape may be obtained, with this red light, almost instantaneously. Such photographs look strange, for the chlorophyll, the green coloring of leaves, is fluorescent, absorbing light of shorter wave length, and pouring out much of the absorbed energy again in the form of light in this extreme red region. When photographed with these rays, therefore, green leaves appear whiter than snow, as though they were self-luminous. Photographs of Mars with these new plates might easily settle the question whether the greenish areas on the planet are produced by vegetation similar to that which fills our forests.

Mention should also be made of a paper by Dr. Silberstein, of the Eastman Laboratory, in which a promising start is made toward explaining, on quantum principles, the spectrum of ordinary helium, which has previously proved intractable to theoretical analysis.

From the Yerkes Observatory, Dr. Van Bisbroeck reported on photographs of the faint outer satellites of Jupiter, and of Phoebe, Saturn's remotest attendant. The latter, and the sixth and seventh satellites of Jupiter, were found close to the predicted positions—indicating that their orbits are already known with considerable accuracy. The eighth satellite of Jupiter, however, was almost a quarter of a degree from its predicted place, showing that a new calculation of its orbit is necessary. This will be a hard job, as the computations are very difficult.

Dr. Otto Struve, a member of the fourth generation of this great family of astronomers, who is for the present at Yerkes, reported on the star Gamma Ursae Minoris, a spectroscopic binary with a period of only two hours and a half, the shortest so far known.

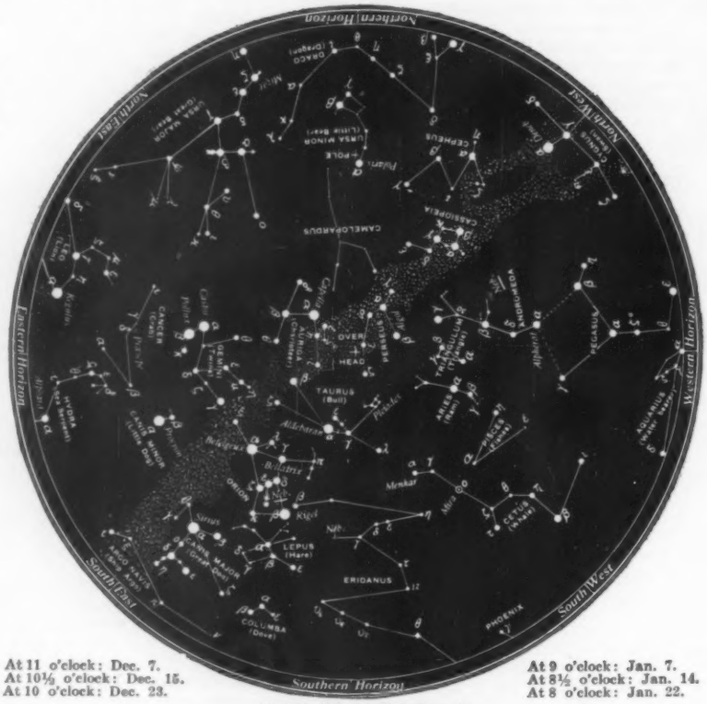
Stars and Atoms

From the Pacific Coast of Canada came a paper by H. H. Plaskett, dealing with certain stars which have spectra of Class O, and which in all probability are the hottest of all. In some of these spectra lines due to hydrogen, and others arising from helium atoms which have lost an electron, are visible side by side, forming close pairs. For both these atomic systems (which are simpler than any others) the positions of the spectral lines have been calculated theoretically by the Danish physicist Bohr. In both cases we have a single electron revolving around the much heavier nucleus of the atom, and it is because the helium nucleus is heavier than that of hydrogen that the lines of the two elements do not coincide. From the difference in their positions it is possible to calculate the relative masses of the electron and of the nuclei in the two atoms. Dr. Plaskett has done this, getting values in excellent agreement with those determined in the laboratory by other means.

While he was engaged in this work, his father, the Director of the Dominion Observatory at Victoria, B. C., obtained a spectroscopic orbit for another star of the same spectral class, which showed that the masses of the components were at least 75 and 63 times that of the sun, far greater in fact than those of any other known stars. From these data, and reasonable estimates of the density and brightness of the stars, he concludes that this star is fully 15,000 times as bright as the sun, and at a distance of 10,000 light-years. This is the only star of spectral class O for which we know the mass, but it is probable that the others, too, are exceptionally massive and brilliant objects. That from a study of these huge luminaries it should be possible to work out the mass of the electron—the minutest of all things—is certainly a striking example of the sweep and extent of the investigations of modern psysics.

It may also be mentioned that the younger Plaskett has found a star in which the lines of ordinary helium have disappeared—presumably because the star's atmosphere is so hot that even the refractory helium atoms have practically all become ionized. This would appear to be the hottest star so far known. Plaskett estimates its surface temperature as 22,000 degrees Centigrade.

Mention may finally be made of two papers by Professor Stewart of Princeton and by the present writer, in which it is concluded from a study of the behavior of various spectral lines, and of the ionization in the atmospheres of the stars, that the pressure in the region where the absorption lines are produced is of the order of 1/1000 of the atmospheric pressure at the earth's surface. This conclusion, which is confirmed by several lines of evidence, indicates that the main part of the line-absorption which enables us to classify the spectre of the stars takes place in the outermost, highly rarified, regions of their atmospheres. Why the deeper and denser layers apparently have so little influence is a problem demanding further study.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

NIGHT SKY: DECEMBER AND JANUARY

The Heavens

The winter constellations have now come fully into their own. Orion is high in the southeast, with the line of his belt pointing up to Aldebaran and down to Sirius. Procyon shines on the left, with Gemini above, and Auriga higher still and extending to the zenith. Leo is rising in the east, and Ursa Major coming up in the northeast. Ursa Minor and Draco swing low beneath the Pole, and Cassiopeia and Cepheus are descending in the northwest. Below them sets Cygnus. The great square of Pegasus stands on one corner in the west, with Andromeda above and Perseus still higher. The great dull constellations Eridanus and Cetus fill the southwestern sky.

The Planets

Mercury is invisible during the early part of the month, since he passes through superior conjunction on the 6th. Being on the far side of the sun, he comes out slowly, and has not reached elongation when the year ends. At this time, however, he sets a full hour later than the sun, and should be fairly easy to see.

Venus is coming out rapidly from inferior conjunction, and showing more and more conspicuously as a morning star. By the end of the month she has reached her greatest brilliancy, and rises only a few minutes after four A. M. Telescopically she appears as a beautiful crescent—at first very thin, then wider.

Mars is an evening star in Aquarius, setting about ten P. M. in the middle of the month. His distance from the earth increases during the month (from 120 to 130 million miles) and his brightness decreases to that of an ordinary first magnitude star.

Jupiter is a morning star, on the borders of Virgo and Libra, and rises about 3:30 A. M. Saturn is a morning star too, rising nearly two hours earlier.

Uranus is an evening star in Aquarius. On the morning of the 20th he is in conjunction with Mars, being only seven minutes of arc north of the brighter planet. On the previous evening Mars will be about a quarter of a degree west of Uranus, and on the next night a little further away on the opposite side. This affords an excellent opportunity to identify Uranus with a field glass. When so near Mars, he will be invisible to the naked eye.

Neptune is on the western edge of Leo, and comes to the meridian at 3:45 A. M. in the middle of the month.

The moon is full at 6 A. M. on the 4th, in her last quarter at 11 A. M. on the 11th, new at 7 A. M. on the 18th, and in her first quarter at 1 A. M. on the 26th. She is nearest the earth on the 14th, and furthest away on the 26th. During the month she passes near Neptune on the 9th, Saturn on the 13th, Jupiter on the 15th, Venus on the 16th, Mercury on the 18th, Mars on the 24th, and Uranus on the same morning. At 10 A. M. on the 22nd the sun reaches his greatest southern declination, at the winter solstice, and in the old almanac phrase "winter commences."

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

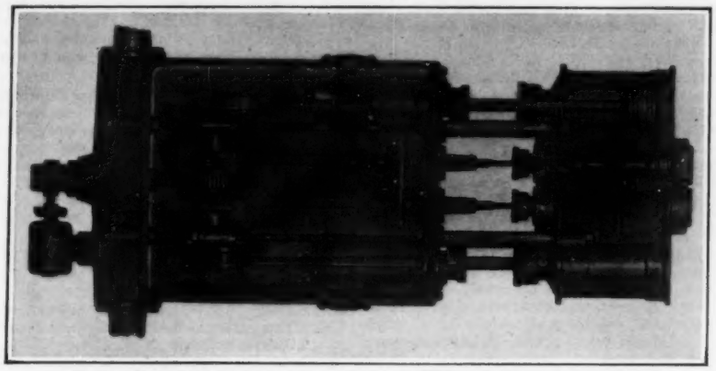
A Light Steam Tractor

THE first type of tractor to receive general application in agricultural work was steam propelled and these for the most part were all of large capacity. They were considerably too large to suit the requirements of the average farmer and called for a skilled engineer to handle them with safety. Some States require that these tractors be operated by a licensed engineer for this reason. The gas tractor in its various forms, especially in the medium-duty types, were evolved to meet the needs of the average farmer.

The machine illustrated is claimed to be the first high-pressure super-heated steam tractor and there is no reason to doubt this. The earlier and heavy steam tractors used wet, low-pressure steam. As our illustrations will show, this new steam tractor is exceptionally compact and is of light weight compared to the early forms of road-roller type steam traction-engines. The illustrations show how closely this tractor approximates the design of the usual internal-combustion-engine-propelled machine. When the hood sides are down it will be difficult for the uninitiated to differentiate between this machine and one of the numerous, very popular types propelled by a gasoline engine. One of the main features of the new tractor is that it employs a boiler of special design for steam production, using fuel supplied to the atomizer burner, which will burn very low grades of liquid fuel.

The boiler is placed under the hood immediately back of the condenser, which is located at the front end of the frame just as the usual water-cooling radiator is placed when the gasoline engine is used for power. There are two water legs at the bottom which run from the front to the rear. These are connected to a steam dome at the top of the boiler by 34 or more seamless steel tubes. These are bent in zig-zag or staggered form in order to provide sufficient heating surface and also to allow for any expansion which might strain the joints if the tubes were straight. The hot gas from the burner not only heats the water tubes but also plays directly on the steam dome located at the top of the boiler, and thus enables it to perform the duties of a steam superheater. The tubes are 11 feet long and have an inside diameter of one-half inch. It is said that the individual tubes are tested prior to assembly to 2000 pounds hydraulic pressure, which is equal to 2500 pounds steam pressure per square inch. The maximum resistance to bursting of the tubes is 25,000 pounds steam pressure, which gives a safety factor of ten over the pressure to which the boiler tubes are tested hydraulically, and a much higher safety factor over the actual pressure in the boiler.

It is evident that the staggered arrangement of the tubes gives a large heating surface in a small space. The boiler steam dome is super-heated by virtue of its construction and location and the boiler also automatically incorporates a feed water heating system. One advantage of this boiler construction is that it provides as many ports of entry for water as it has tubes, thus providing unusually good water circulation. When fully assembled, the tubes are covered with one-inch-thick asbestos sheet and are incased in sheet iron. The boiler construction is very accessible and individual tubes can be removed and new tubes replaced in a very short time as tubes can be removed from any part of the boiler without disturbing the others. In case one of the tubes should become damaged in the field, it may be removed and the openings in the water legs and steam dome plugged up by ordinary pipe plugs without any material loss of efficiency.

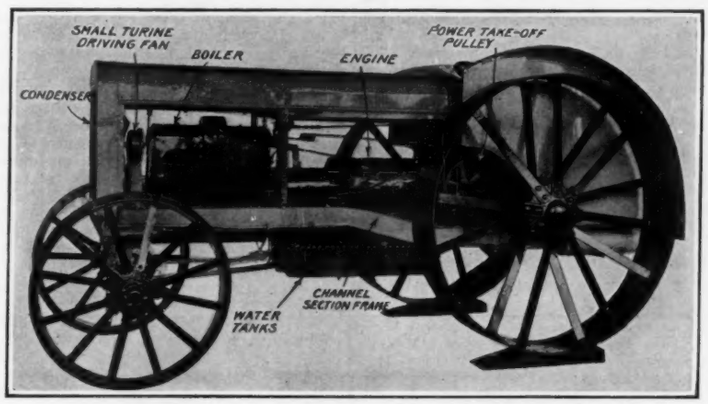


Part sectional view of the engine used in the light steam tractor

It is stated that scale formation in this boiler is eliminated by the lubricating system employed. The oil supplied to the cylinders of the engine is exhausted into the condenser and passes out with the water return to the water tank. It is pumped from that container into the boiler tubes with the feed water. The oil collects on the inner walls of the tubes forming a protection against deposition of scale in the tubes. Any sediment that is produced in this boiler lodges in the water legs and can be easily removed by opening the end connections of the water legs. It is claimed that the boiler will not require washing out more than once a year due to the efficiency of the condensing system. A steam pipe running from the steam dome to the control throttle is arranged in such a way that only dry super-heated steam is supplied to the engine, the end in the dome being upturned.

The engine is rated a 26-70 horsepower and is a two-cylinder, double-acting, piston-valve type of four inches bore and five inches stroke. The maximum speed is 800 revolutions, and the engine is stated to pull effectively at a minimum speed of 20 revolutions. The normal working pressure of the boiler is 550 pounds. The valve gear is a Stephenson link-type. The engine is placed in the frame directly back of the boiler and is the completely enclosed type which is so popular in modern steam automobiles. The engine is geared to an intermediate spur-gear that drives the counter-shaft on which the power take-off belt pulley is placed and this shaft drives the differential ring-gear in the live rear axle.

Two 35-gallon tanks are carried under the frame, as indicated in the illustration, for fuel and water supplies. A smaller tank of three gallon capacity supplies gasoline for the pilot light. A small steam turbine, which is used to drive the fan back of the condenser directs its exhaust steam to a device which assists in the atomization of the fuel. The boiler feed is accomplished by a water pump driven from the gear at the power take-off pulley drive shaft. The regulation of the boiler feed is accomplished by a small valve on the dash convenient to the operator. Two other pumps are driven from the counter-shaft, one to supply fuel to the burner, the other to insure a positive delivery of lubricating oil. The driving gears in the rear axle cross-shaft assembly revolve in an oil bath. Both of the pumps are of the plunger type. Roller bearings are used throughout the transmission mechanism and in the axles.



General view of the tractor, showing all the major parts

The tractor has a wheel-base of 88 inches, it weighs about 3400 pounds and is about 12 feet long over all. It is five feet, four inches high and 72 inches wide. Its ground clearance is 16 inches and its turning radius is 11 feet. The speed variation is, of course, unlimited as is true of all steam-propelled automotive apparatus. The minimum speed claimed is one-eighth of a mile per hour and any intermediate speed in the range to the maximum, seven and a half miles per hour, is obtained by a simple throttle control under the steering wheel. It is stated that one tank of water will suffice for ten hours continuous work.

The running gear and wheels follow conventional tractor construction, the frame being built of structural steel, channel section. The front axle is an auto type steel casting having reversed Elliott steering knuckles. Contracting band brakes are used, these being lined with asbestos friction facing. The instrument board, which is located immediately in front of the driver, carries a steam gage, water level indicator and also lubricating-oil sight-feed. The front wheels have a diameter of 34 inches and are of a built-up type having a central ridge to prevent side slip. The rear wheels are five feet in diameter and have rims 12 inches wide. While these wheels are shown with plain rims, these are drilled to hold driving cleats. Suitable traction cleats of 2½-inch angle iron are provided which are held to the steel rim in the usual manner by bolts. The power take-off belt pulley is 14 inches in diameter and 6½-inch face, and runs at 2800 feet per minute.

The general construction of the tractor and its parts is clearly shown in the accompanying illustrations and to those who are familiar with steam tractors it will be apparent that just as the gasoline tractor builders have drawn upon the fund of experience gained in production of automobiles propelled by that power, the designers of this new tractor had the good judgment to avail themselves of the development that has taken place in steam propelled, passenger-carrying automobiles. This novel tractor is attracting considerable attention and there is no reason why it should not prove to be a very useful piece of agricultural machinery, especially in the estimation of those who favor steam to other prime movers.

Truck Wheel of Rolled Steel

A ROLLED steel truck wheel in which the rim and spokes are formed in one piece is now being produced by one of the large steel manufacturers. The blank from which the wheel is formed is stamped in the first instance from a special rolled I-beam, portions of which to form the spaces between spokes being cut away before the forming operation is started. When the wheel has been formed to assume a circular shape, the ends of the flange which then becomes the rim of the wheel are welded together, and the inner spoke ends are bolted to a central hub member, alternate spokes being staggered and bolted to opposite sides of the hub flange. The wheel forms a rigid structure which is said to compare favorably in weight with that of a wood wheel, and to be amply strong to withstand the most severe radial loads and side thrusts as well as torsional strains.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

MEANS FOR STABILIZING AIRPLANES.—S. DE SANTIS, c/o Barzano & Zarnado, 9 Via Due Macelli, Rome, Italy. The invention relates to flying machines and particularly to the stabilizing of the wings, that they may have a constant supporting or lifting power. The device consists of a lever mechanism adjustably connected with a pivoted stabilizing wing and to which a spring is secured.

AIRSHIP.—C. J. COOKE, 31 B St., S. W., Washington, D. C. An object of this invention is to provide a device by means of which the decrease in weight carried by a gas bag, which ordinarily occurs from the consumption of fuel in the internal combustion engine by means of which the airship is propelled, is compensated, either wholly or in part, by the condensation of the aqueous portions of the products of combustion, these condensed portions being conserved as ballast.

Pertaining to Apparel

BELT BUCKLE.—T. B. HAFERTEP, 6218 S. Laflin St., Chicago, Ill. An object of the invention is to provide a belt buckle having means for engaging with an article of apparel underlying the same, whereby the belt buckle is maintained in adjusted position. A further object is to provide a device that has the appearance of a belt buckle of an ordinary construction, and is effective for the purpose intended without interfering in any way with its functioning in the usual manner as a belt buckle.

Chemical Processes

FOUNDRY MOLDING MATERIAL.—F. G. DOKKENWADEL, 917 Herald Square Hotel, 34th St., New York, N. Y. An object of the invention is to provide a foundry molding material capable of withstanding the heat of molten metal and to allow repeated reuse of the molding material. It consists of the following ingredients in about the proportions mentioned: Lime, 50.15 per cent; sulfur, 27; magnesium, 1.53; silica, 2.60; alumina, 24; iron oxide, 60. In practice about three parts of the material is mixed with one part of finely reduced graphite.

Electrical Devices

KEY CONTROL TELEPHONE SWITCH.—D. C. WALKER and B. WEEKS, 411 Grand Central Station, Memphis, Tenn. The object of the invention is to provide a simple device for protecting telephone installations, in isolated telephone stations, from high potential electrical discharges and from unauthorized use. To this end a normally open gap is provided in the substation circuit, and a particularly constructed key for closing the gap, thus preventing unauthorized persons using the instrument. (See Fig. 1.)

BATTERY CONTAINER.—R. W. TAYLOR, 4415 Berkeley Ave., Chicago, Ill. Among the objects of the invention is to provide a battery container adapted to house a plurality of dry cells and having means for connecting up such cells in either series or multiple in such manner that any cell may be replaced at will. The device is light in weight, compact, relatively simple in construction and operation, not likely to get out of order easily, and adapted to be carried about in a small handbag, or the like.

Of Interest to Farmers

RESTRAINING APPARATUS. — G. CORTEZ, address E. M. McLaughlin, 2643 Mommouth Ave., Los Angeles, Calif. The invention relates to a restraining apparatus and operating table especially adapted for use in connection with pigs. An object is to provide a restraining or holding apparatus which may be employed for safely holding a pig while being operated upon. The device may be readily adjusted for use in connection with pigs of various sizes, and may be operated entirely by one man, the operator having free access to the animal. (See Fig. 2.)

HARROW.—F. G. BIGGERSTAFF, 2627 Tracey Ave., Kansas City, Mo. The object of this invention is to provide a harrow which may be rendered operable or inoperable at will and while in motion, which may be raised above the ground, by means of a cam-lever, whereby to be cleared of accumulated debris, and which is of simple and durable construction, reliable in operation and easy and inexpensive to manufacture. The harrow may be drawn by tractor or other suitable means. (See Fig. 3.)

MOWING MACHINE.—C. R. KEAGLE, 106 Linden Ave., Joliet, Ill. The invention has for its object the provision of a power-operated means for lifting the cutter bar of a mowing machine to an inoperative position, and it is so constructed as to be operated by power derived from the drive wheels and may be controlled by one foot of the operator when the machine is advanced by draft animals, and which will permit the operation thereof by a single operator on a tractor.

CYLINDER FOR THRASHING MACHINES.—R. H. OWEN, 403 Lewisohn Bldg., Butte, Montana. The object of the invention is the promotion of a cylinder of simple, economical structure in which provision is made for the ready renewal of broken or otherwise unserviceable teeth, and a further object is to enable the teeth to be replaced easily and quickly without the necessity of long complicated wrenches, and to hold the teeth rigidly against displacement.

GRAIN CLEANER.—F. FOWLER, 1112 Clifton Ave., Moose Jaw, Saskatchewan, Canada. The invention aims more particularly to provide a simple mechanism which may be attached to a conventional thrashing machine, and by means of which the chaff will be separated from the grains, these grains in turn being subdivided into a lighter and heavier grade, and the dust separated from this latter.

SWEET-POTATO-VINE CUTTER.—A. B. PURDOM, Blackshear, Ga. The invention relates to cutting attachments for plows. An object is to provide means to readily and simply attach to any type of plow a cutter, whereby vines disposed over the ground in advance of the plowshare can be cut to enhance the travel of the plow through the ground. The knives may be easily adjusted to meet various requirements, and will not become choked up in operation.

FEEDER.—E. D. RICHARDSON, Cawker City, Kans. This feeder is particularly applicable for use in connection with a thrashing machine. An object of the invention is the construction of a feeder in which that end of the body of the same opposite to the end which is associated with the threshing machine shall be in a plane at which the stacks may readily be placed upon the same. The feeder is constructed to stand hard usage.

PLOW.—R. H. WILSON, New Holland, Ill. An object of the invention is to provide a form of plow having means for preventing the accumulation of adhesive soil on the moldboard. A further object is to provide a moldboard having a fixed frame and a movable body portion, in which the movable portion may be replaced cheaply and readily when worn by service.

Of General Interest

ATTACHMENT FOR AWNINGS.—J. A. LENHOFF, 1327 Dupont St., Wilmington, Del. The general object of the invention is to provide an attachment which may be used in connection with an awning and through which the cord passes to guide the cover and in a manner to maintain the cord out of rubbing contact with the awning to prevent wearing holes in the awning material, and to prevent the material being caught at the pulley.

ARTIFICIAL BODY MEMBER.—R. F. ARMSTRONG, 121 W. 8th St., Kansas City, Mo. The invention relates more particularly to artificial hand members. The object is to provide a device of this character which is in general capable of pushing, pulling or grasping, so as to enable the user to perform various kinds of work with ease and efficiency, which is adjustable and easily operable, is of simple and durable construction, reliable, and inexpensive to manufacture.

BUCKET.—W. L. THOMPSON, Greenville, Miss. The object of the invention is to provide a drag line bucket especially adapted for transporting earth short distances, and which will be under the complete control of the operator irrespective of the material upon which it is acting, and is especially adapted to efficiently carry out the digging of hard material and conveying the same to the desired point.

FRUIT JAR AND COVER.—W. R. NIPPER, address H. D. Norton, First National Bank Bldg., Grants Pass, Oregon. An object of the invention is to provide an attachment for fruit jar covers of conventional construction which is adapted to be attached to the cover to suspend within the jar and which operates to hold the contents of the jar below the level of the liquid therein, thereby precluding the possibility that mold may form on the contents of the jar.

STIFFENER FOR FOLDING BOOKS.—W. O. LYNCH, c/o Mills Estate, Milbrae, Calif. The principal object of the invention is to provide a stiffener for folding check books. A further object is to provide a plate about one-half the length of the ordinary folding check book, which will act to flatten the check so that the crease formed by folding will disappear and the check may be conveniently written on.

CONTROLLER FOR FISH LURES.—C. M. RODGERS and A. W. WENGER, c/o Wenger Mfg. Co., Warsaw, Ind. The invention relates to artificial baits or lures. An object is to provide an attachment for an artificial bait that is adapted to control the movements of the bait when it is drawn through the water. A further object is to provide a device that can be adjusted to cause the bait to remain at various depths, and to control the wiggling movement as it is drawn through the water. The device may be readily attached to a bait body of any ordinary construction.

FOOT SUPPORT.—A. ROTH, 63 Giraid Place, Newark, N. J. The invention refers more particularly to a support for fallen or broken arches, the device being so constructed as to support the heel and arch of the foot, and is adapted to overcome and cure the above recited trouble. The device is light and comfortable, and is readily applicable to the shoe.

SELF-CLOSING AND CONTROLLING MEANS FOR DOORS. — B. SPITZFADEN, 275 Water St., New York, N. Y. Among the objects of the invention is to provide a self-closing means for doors, such as elevator doors, the invention being adapted for closing either a single or sectional door. The device includes a vertical guide rod, a vertical sliding element, a level pivoted to said element, and spring means exerting pressure at one end in a direction to move the lever for closing the door.

SHOE.—E. MAGALDI, Naples, Italy. The object of the invention is to provide a heel for shoes having a sheet metal upper portion provided with a flange adapted to extend around the rear part of the shoe to stiffen the same. A further object is to provide a heel with the portions which are subject to wear removable, that they may be readily substituted.

KITCHEN CABINET.—DE KALB TURBEVILLE, Roanoke, Ala. An important object of the invention is to provide a kitchen cabinet having compartments for the reception of flour, meal and the like, which compartments are automatically locked when the cabinet cover is lowered; openings are provided to receive containers for necessary articles for use in connection with cooking; the cabinet top may be used as a flour board; the cover when lowered making the cabinet dustproof. (See Fig. 4.)

COMBINATION HANDLE AND CRANK. — P. L. STREIT, Grand View, Nyack, N. Y. The object is to provide a crank that may be converted into a handle for carrying or other purposes. A further object is to provide a crank that may be attached to any shaft, and having a hinged handpiece that may be rotated through an

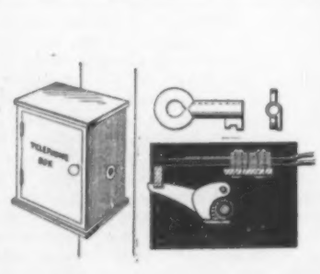


Fig. 1: Telephone that can be used only by those holding a key—the invention of D. C. Walker and B. Weeks

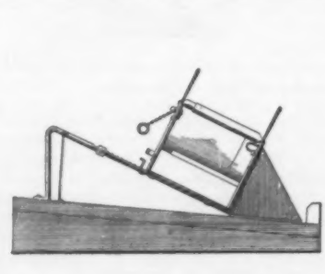


Fig. 2: G. Cortez's device for facilitating surgical operations upon pigs

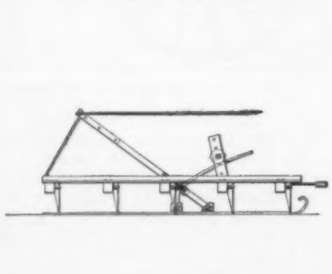


Fig. 3: Harrow of unusual adjustability, patented by F. G. Biggerstaff

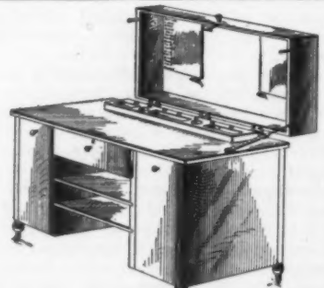


Fig. 4: Kitchen cabinet of improved design put out by De K. Turbeville

angle of 180 degrees from its position, extending outward at right angles to the crank arm, to engage with a stud mounted on the casing enclosing the shaft to which the crank is connected.

FOLDER FOR PRESCRIPTION BLANKS.— R. B. and L. TAYLOR, Melville, Saskatchewan, Canada. The general object of the invention is to provide a device having novel securing means for the sheets so arranged that a large number of sheets can be secured in a small space and compact form as well as in a manner that all the sheets may be identified by number, page, or the like.

SHOEHORN.—I. O. HARMS, Hillsboro, Kans. An object of the invention is to provide a shoehorn equipped with a handle member, which will obviate the necessity of the user bending over to put on a shoe. A further object is to provide a device with a shoe engaging member, which will cooperate with the horn proper in forcing the shoe upon the foot.

CONCRETE BUILDING STRUCTURE.—J. PARTEE, Santa Cruz, Calif. The invention relates to the construction of concrete houses, barns, silos, ships and all building constructions, wherein a framework is provided with a network of reinforcing wires and a metallic reticulum adapted to receive and retain the concrete filling to form an enclosing structure. The primary object is to provide a framing structure adapted to receive and support a concrete filling.

HEEL FASTENER.—L. CERF, 49 Maiden Lane, New York, N. Y. Among the objects of the invention is to provide a heel fastener arranged to securely fasten the heel in place and to reinforce and strengthen the heel. The device is adjustable to any angular variation between the heel and the sole, and arranged to permit of fastening heels of different heights securely in place on the shoe.

MOLDING.—E. S. LIDSTONE, Box 203, Gatun Canal Zone, Panama. The invention particularly relates to metal moldings, an object being to provide a molding which will present an attractive ornamental appearance, and yet which may be conveniently utilized as a channel casing for electric light wires leading to various parts of a house, and will serve to hide the wires from view. The molding is simple, easy to apply, and fireproof.

ARROW.—R. P. ORR, 35 S. Manning Blvd., Albany, N. Y. An object of the invention is to provide an arrow of any usual construction, with a head having an end member of resilient material confining the quantity of air whereby an air cushion is presented, and means for confining the air, without interfering with the provision of a proper weight to the head.

POWDER PUFF.—W. KROHN, 2772 Main St., Buffalo, N. Y. Among the objects is to provide a device which will function both as a powder puff and a powder dispensing receptacle, which will be neat and attractive in appearance, simple in construction, being made of material particularly adapted for spreading the powder, and comparatively expensive to manufacture.

LIFE BELT.—M. HEATH, c/o I. E. LETNER, 156 W. 170th St., New York, N. Y. The invention particularly relates to pneumatic life belts adapted to be secured about the waist of the user, an object is to provide a simple and durable device, with means for inflating the belt in a manner to insure that the tube will not be accidentally compressed against the ready entrance of air, when it is desired to inflate the belt.

ICE CREAM CONTAINER.—R. K. DENT, Akron, Alabama. The purpose of the invention is to provide a container so inexpensively constructed as to permit of its being discarded after use, thus avoiding the necessity of returning the container, as in the case of metal containers, and the expense attending such return, as well as the reduction in cost of shipment by virtue of the difference in weight.

SHIP HULL CONSTRUCTION.—J. DUTHIE, SR., 648 Belmont St., Portland, Oregon. The object of this invention is to provide a ship hull, which provides greatly increased tonnage for a hull of given length and draught than heretofore provided and at the same time greatly increases the metacentric stability of the vessel by providing an immersed wedge of maximum efficiency, and which greatly increases the speed per horsepower per ton.

VENTILATING DEVICE.—DE WITT T. LYON, 213 W. Austin Ave., Chicago, Ill. Among the objects of the invention is to provide an adjustable ventilator of the so-called mushroom type that is adapted to be quickly adjusted, and provided with means for locking the relatively movable parts together in any adjusted position. A further object is to provide a device designed to deflect a current of air as desired.

BRIEF CASE.—M. KLOMBERS, 16 E. 18th St., New York, N. Y. The invention has for an object to provide a construction of corner whereby the front and back walls as well as the intermediate positions may be close together when the device is empty. Another object is to provide a brief case with pressed corners whereby the edge walls may properly fold along the edge and bottom and lie comparatively flat at the corners.

TOY HOUSE.—F. J. VARNUSKA, 422 E. 77th St., New York, N. Y. The invention relates to a toy in the form of a building adapted to be knocked down and reconstructed. An object is to provide doors and windows for the house of such character that they may be placed upon any side of the house and the side walls completed therearound.

ROAD GRADER.—C. H. WELSH, Verona, Ill. An important object of the invention is to provide a road grader wherein the main blade may be readily and conveniently adjusted, and is provided at its ends with hinged wings or extension blades which are positioned for the purpose of picking up a quantity of dirt for filling the low places in the road and for leveling roads.

SCALE.—J. FRAME, Searsport, Maine. The invention aims to provide a scale which shall be operated with a minimum of mechanical movement. The scale includes a pair of connecting tanks, a platform within one, and a float within the other, said tanks being adapted to receive fluid for permitting a suspension of both the platform and float, mechanism connected with said platform for permitting the introduction and escape of additional fluid within the tanks proportionate to the movement of the members within the same.

VAPOR BATH.—J. THOMAS, Aberdeen, Wash. An object of this invention is to provide a device which may be associated with a conventional bath tub, and may utilize the steam inherent in the hot-water system. A further object is to provide a device in which the steam and vapors will be confined, and when not in use may be stored in a relatively small space.

ADJUSTABLE ROOF COLLAR.—O. M. REDLON, 181 Front St., Bath, Maine. The invention relates to a roof collar which permits pivotal adjustment between the collar and the sewer pipe so as to insure a proper relative positioning of the collar and the pipe and enable a tight joint to be made and to prevent the passage of water inside of the collar. A further object is to provide an adjustable collar which can be made in any size to suit the pipe employed.

TROLLING SPOON.—W. J. EGGLESTON, 3211½ Hewitt Ave., Everett, Wash. The invention relates generally to trolling spoons used in fishing and is more particularly a fish-shaped spoon capable of slow revolving movement in the water by virtue of its particular shape, the object being to provide a simple device which may be readily formed and cheaply constructed in a single operation.

WATCH FOB.—J. E. CHURCH, Box 230, Providence, R. I. An important object of the invention is to provide a button or pin to be used in the buttonhole of a coat lapel for a watch fob wherein the attaching member of the same is formed from a single length of wire with a plurality of bends to provide a series of open-ended loops, adapted to adjustably receive the ribbon of the fob whereby the loops formed may be of various sizes for supporting the watch in an upright position within the pocket.

CONTAINER.—J. J. SHUMAKER, 1284 E. 134th St., Cleveland, Ohio. The invention relates to a measuring device comprising a normally vertical and elongated transparent body formed with alternate bulb-shaped containers and short, narrow tubular connecting portions, each tubular portion being provided with a series of gradations indicating the capacity of the device, thus providing for accurate measuring.

WALL CONSTRUCTION.—W. G. DEMAREST, 68 Rector St., Metuchen, N. J. Among the objects of the invention is to provide a composite brick and tile wall construction in which the tile and brick facing are properly organized to obtain a high degree of strength and in such manner as to provide continuous air passes through the tile to prevent moisture from penetrating through the wall into the interior of the building, and in which the full load strength of the tile is taken advantage of to reduce the amount of steel framework necessary.

TOILET OUTFIT.—S. R. SVENDSGAARD, Portland, Oregon. This invention relates to a portable toilet or lavatory outfit or equipment which provides motorists or others with the facilities necessary to enable them to thoroughly cleanse or wash the hands or otherwise satisfactorily prepare the toilet. The device is simple, durable, compact and attractive in appearance, contains water, soap and towels, and may be readily associated with standard types of motor vehicles.

CRATE FOR MILK BOTTLES.—W. LYNCH, 613 McDonough St., Brooklyn, N. Y. One of the primary objects of the invention is to construct a crate which is especially adapted for properly positioning milk bottles during the sterilizing operation. A further object is to provide a form of metallic supporting means adapted to center the bottles when in inverted position, and to prevent the bottle mouth from becoming chipped.

CLOSURE.—H. R. PAUSIN, 123 William St., Room 311, New York, N. Y. Among the objects of the invention is to provide a receptacle particularly adapted to contain motion picture films. A further object is to provide a device of this character in which means will be provided to prevent any accidental opening of the closure irrespective of the rough usage to which it may be subjected.

WINDOW PANE FASTENER.—W. LEICHTFUSS, Wooley Ave. and Madison St., Elmhurst, N. Y. The invention relates to fasteners for securing and retaining window panes in the sashes in lieu of putty. The device is especially designed for use in connection with hot-house sashes, where the putty has a tendency to crack and dry out owing to the extreme heat. The device is simple, easy to apply or remove, and inexpensive.

RUBBER HEEL.—A. E. ROPE, Hotel St. George, Brooklyn, N. Y. The object of the invention is to provide a rubber or composition heel adapted to be secured to the lower face of an ordinary leather heel. A further object is to provide heels of the character stated which are formed of a plurality of sections so that the sections of the respective heels can be readily interchanged to compensate for wear, and thus compel the heels to wear evenly through the life of the shoe.

HAT STRETCHER AND SHAPER.—D. FREEDLINE, 1250 Fulton St., Brooklyn, N. Y. The invention has for an important object the provision of a hat shaper and stretcher having increased possibilities in localized adjustments of the shaping elements to very effectively conform the hat to the peculiarities of conformation in a particular cranium. The device is conveniently and speedily operated.

TELEPHONE DIRECTORY.—C. R. HILBERRY, 435 Mary St., Flint, Mich. An object of the invention is to provide a directory which is adapted to be applied to the transmitter of a telephone instrument, and which affords facilities for presenting a plurality of names and their respective telephone numbers to view selectively in such manner that the names and numbers are disclosed in horizontal position and are spaced apart.

ROPE OR STRAP FASTENER.—E. D. BARTON, 116 S. 7th St., Canon City, Colo. The invention relates to devices adapted to be detachably secured to a support to provide a means to which a flexible member, such as a rope or strap, may be secured. An object is to provide a simple, positive acting device which has relatively adjustable means for engaging supporting objects of various sizes and shapes, such as parts of an automobile.

WATCH AND JEWELRY CLEANER.—B. MCCARTY, 410 Franklin St., Tampa, Fla. Among the objects of the invention is to provide a simple, inexpensive and easily operated device of the character specified, by means of which the disassembled watch movements may be thoroughly cleaned in a very short time, and with a minimum of labor. The device comprises receptacles for clean water, for a cleaning solution, and for fine boxwood sawdust.

CUSHION FOR TELEPHONE RECEIVERS.—O. W. AAGAARD, 5144 N. Albany Ave., Chicago, Ill. An object of the invention is to provide a device of soft rubber having a bearing surface which entirely encompasses the ear, and which enables the user to shut off all noises from the outside. The device may be quickly attached to or removed from the ordinary type of receiver now in use.

PAPER BOX.—S. BERGSTEIN, c/o Interstate Folding Box Co., Middletown, Ohio. The invention relates to a box having side and end panels, the side panels being scored transversely to form flaps to cover and reinforce the end walls, the end panels also being scored transversely to provide flaps adapted to lie on the bottom of the box, each of said last-mentioned panels being also provided with side flaps adapted to cover and reinforce the entire surface of the side walls of the box.

SECURING DEVICE.—F. C. ANDERSON, 212 Danforth St., Portland, Me. The invention is primarily intended for use in connection with clotheslines. It is an object to provide a securing device by means of which the line will be held in a proper manner without any danger of its slipping, and in which it will not be necessary to knot the body of the rope to establish a connection, and by means of which an operator may readily effect a detachment or loosening of the rope.

CARBOY.—C. LEFKOWITZ, E. E. ROSS and H. LUBIN, 348 South St., Newark, N. J., c/o National Box & Lumber Co. An object of the invention is to provide a carboy which will effectively cushion the vertical as well as the lateral jolts and jars incidental to the transportation of a large bottle of liquid. A further object is to provide a cushioned carboy formed entirely of wood so that it will be particularly useful for carrying bottles of acid.

COMBINED TIE AND FASTENER.—A. LERNER, 269 Rochester Ave., Brooklyn, N. Y. The invention has for its object to provide a construction wherein the tie may be held in proper place by a collar button without danger of the tie rotating or moving out of correct position. A further object is to provide a collar button and tie, wherein the tie is provided with a socket for receiving a button with a similar formed head and a flat shank.

SIGN.—V. GUARDINO, 3014 Ocean Ave., Sheepshead Bay, Brooklyn, N. Y. It is an object of the invention to produce a sign adapted to be placed upon a supporting surface from which it may be readily removed and new matter inserted, the member carrying the display or advertising being attached to the sign structure so that virtually one unit will be provided.

REEL.—R. D. PETERS, Knox, Ind. This invention relates to a combination casting and line-drying reel in a unitary construction, in which a perfect casting can be made for a comparatively great distance, and in which the unwinding of the reel is at all times under the control of the angler's thumb, and also in which the danger of back-lashing is entirely obviated. The tension may be regulated so that the reel will wind or unwind at varying speeds.

CRATE.—J. COBB, Box 244, Laredo, Texas. An important object of the invention is to provide a folding crate having means whereby the same may be readily and conveniently collapsed for return shipment, and having corner posts of considerable greater strength than the side slabs so that the crate is enabled to withstand the hard usage to which it is subjected when being filled and when being transported.

SCREEN FRAME.—F. MUSHALL, 2827 Elston Ave., Chicago, Ill. An object is to provide a screen in which the frame may be fitted into various sizes of window casings. A further object is to provide a screen, having a frame which may be placed in a window casing, and in which any play between the frame and the casing is automatically taken up, thus preventing rattling of the screen.

GUN CLEANING DEVICE.—J. H. CUMPSTON, 1006 Pamp St., c/o Negro & Co., Dallas, Texas. Among the objects of the invention is to provide means for retaining a cleaning rag in unwrinkled position upon the end of a ramrod, and to provide means for tightly wrapping the rag around the rod to prevent the rag from slipping off before it is inserted in the barrel of a rifle, and to provide a device which will be simple and practical.

AUTOMATIC VALVE.—E. J. FORTIER, 262 E. Chestnut St., Kankakee, Ill. The object is to provide an automatic valve for a drain pipe in a water system which will

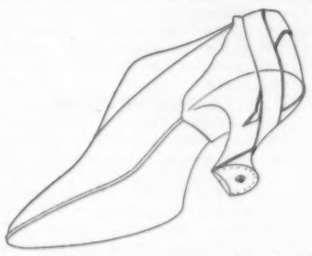


Fig. 5: Device by means of which E. W. Wood has simplified the repair of shoe heels

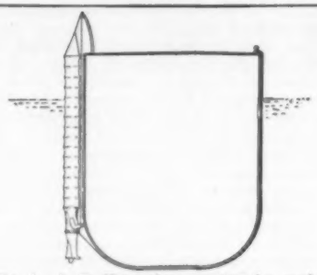


Fig. 6: A. B. Hansen's apparatus for working on the submerged parts of ship hulls

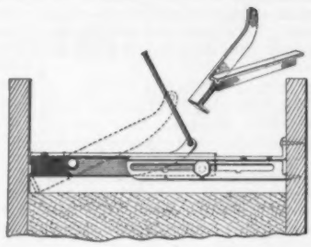


Fig. 7: Spreader for use in building concrete walls, patented by H. T. Swasey

be opened by the suction created by the rush of waste water down the drain pipe, thereby preventing siphoning of the liquid seal from the trap in the water system without the necessity of providing a ventilating pipe. A further object is to provide a device that will automatically close when the waste water has ceased to flow and will normally remain closed.

HEEL BINDER.—E. W. WOOD, 250 Emerson Place, Brooklyn, N. Y. The object of the invention is to provide a heel binder for shoes, more especially designed for securely holding the split portion of the sole in position on the breast of the heel during the time the glue or other adhesive substance used for fastening the split portion of the sole to the heel is setting and hardening. The arrangement permits the workman to quickly apply or remove the binder. (See Fig. 5.)

APPARATUS FOR SUBMARINE WORK.—A. B. HANSEN, Nordland, Wash. The primary object of the invention is to provide an apparatus which is simple in its construction and readily operable by persons of ordinary intelligence and mechanical ability. Another object is to provide an apparatus to form an element of a ship's complement which is capable of use in cleaning or repairing submerged portions of the hull, and may also be used for a man to descend into a filled oil tank to do repair work. (See Fig. 6.)

SPREADER.—H. T. SWASEY, 27 Ewing St., Trenton, N. J. The invention relates to a device for use in building concrete walls, in such manner that the same may be made of uniform thickness, and kept straight and plum. The object is to provide a collapsible extension spreader to be temporarily placed between the wall molds to hold them in uniform spaced relation. The device may be easily removed and repositioned at a higher elevation. It is made in different sizes, accurately gaged and may be set to any measurement. (See Fig. 7.)

PACKING CASE.—H. H. READ, 84 Cranley Gardens, Nuswell Hill, London, N. 10, England. According to this invention the contiguous edges of boards forming the sides and ends of a packing case are connected together by means of angle plates in each of which one branch is disposed between the contiguous edges and is secured to the edge face of one of the boards while the other branch is secured to the inner or outer face of the contiguous board. Preferably the angle plates are slotted so as to permit a hoop iron binding strip to be passed through all the plates.

REVERSIBLE WINDOW. — F. W. BOWLER, 3819 Wentworth Ave., Chicago, Ill. An object of the invention is to provide a window construction having glass carrying sashes slidable vertically in an ordinary manner and also arranged to be revolvable at will in either raised or lowered position to permit cleaning both sides of the window without danger or inconvenience to the operator. The device can be used with window frames of ordinary construction.

PROCESS OF PRODUCING EDUCATIONAL PHOTOGRAPHS.—C. F. MERRIAM, P. O. Box 13, Ambassador Station Hotel, Los Angeles, Cal. The invention relates to a book, and has for its object to utilize material prepared for other purposes, such as moving picture scenes at certain stages of the scenes for producing still pictures, which will give a substantial and accurate story of the matter presented by the moving pictures when completed.

TRAP.—H. W. JUSTUS, Napanoch, N. Y. The invention particularly relates to traps for water of condensation, an object being to provide a trap automatically controlled by a float, which controlling the operation of the valve regulates the flow and pressure to a diaphragm control for operating the outlet valve of the trap.

TYPOGRAPHICAL SLUG.—L. C. TINSLEY, 1935 Creston Ave., Bronx, N. Y. An object is to provide a slug comprising a plurality of sections fragilely connected at the type face so that said fragile portions can be broken away after the slugs are set up in a galley. A further object is to provide a slug which can be cast in any ordinary typographical machine, employing ordinary matrices.

TELESCOPE.—H. W. HALES, 95 Spring Ave., Ridgewood, N. J. This invention relates to an instrument that is extremely light and compact and gives about twice the power of the ordinary telescope size for size. There are no prisms to tarnish or get out of alinement as in the prism binocular, yet the instrument gives all the plastic effect of the prism binocular, and is much lighter, simpler in construction, and of very much higher power.

COMBINATION FURNITURE.—N. J. GREENISON, 1962 University Ave., Bronx, N. Y. Among the objects of the invention is to provide a step-ladder, stool and shoe-shining box, especially adaptable for kitchen use. A further object is to so construct the step-ladder that the spread thereof is limited by means carried upon the shoe-shining box.

PROCESS AND APPARATUS FOR PRODUCING AND MAINTAINING A VACUUM.—T. TIBBETS, Ellicott City, Md. An object of the invention is to provide a process whereby a partial vacuum may be produced and maintained, and in which the necessity for mechanical devices such as pumps, condensers, etc., is eliminated. A further object is to provide a process which may be carried out with any ordinary boiler, by the addition of a U-shaped tube which may be attached, or built in the boiler.

Hardware and Tools

VALVE TOOL.—C. D. SEVIER and F. P. ECKBOAT, 1902 E. 34th St., Kansas City, Mo. An important object of the invention is to provide a valve tool which will effectively remove the inner valve stem from the valve casing when the lugs on the valve stem have been broken off and when the valve stem has been broken off below the plug.

OILING DEVICE.—P. W. BURKE and A. J. BREEDING, 215 Olive Ave., Long Beach, Calif. The invention relates to oil feeding devices for pneumatic drills and similar tools actuated by the release of compressed air, and its particular object is to provide an automatic oil feeding device that will work whenever the tool is being used, does not depend upon the operator, delivers oil to the parts needing it in a continuous flow or spray-like stream which can be adjusted to suit conditions.

FACING TOOL.—J. A. SHARPNACK, Rices Landing, Pa. An object of the invention is to provide a facing tool particularly useful in facing steering knuckle yokes of automobile axles, or may be employed for a variety of purposes, and requires no special skill for its manipulation. A further object is to provide a tool by means of which smooth and even faces can be easily and rapidly formed, and with which cutters of different kinds and sizes can be used.

CLAMP.—H. RIGERT, 431 48th St., Brooklyn, N. Y. The primary object of the invention is to provide a clamp in which a pair of movable jaws are slidable upon an ordinary bolt. A further object is to provide means for bracing the jaws against strains incidental to the clamping of work between them and to provide means for preventing bending of the rod or bolt when work is clamped between the jaws.

HINGE CHECK.—G. VUILLE, 14 Wenty Ave., Shelby, Ohio. The invention relates to hinge checks for double swinging doors, a purpose is to provide a hinge check which is operable to permit of the ready opening of the door in either direction, maintaining the door in a 90-degree open position, and automatically closing the door when moved from such angular position. Furthermore, the invention includes fluid control means operable to retard the closing action irrespective of the angle which the door occupies when released.

ROTARY GLASS CUTTER.—C. F. DOERR, 260 W. Broadway, New York, N. Y. The invention relates to glaziers' implements, and specifically refers to means for circumferentially adjusting the cutter head on the carrier sleeve, therefore to simplify the construction of said means and the operation of bringing the various disc cutters into active relation to the surface to be cut.

GRADE SIGHT.—E. J. BENOIST, Casilla No. 393, Vina Del Mar, Chile. An important object of the invention is to provide a device for use in ascertaining the grade or slope in underground work, which is simple in construction, convenient in use, and embodying elements which may be separated so that the device may be carried in the pocket or the like.

MAGAZINE BRACE.—S. J. MORGAN, c/o Albany Hardware Specialty Co., Albany, Wis. An object of the invention is to provide a device of the character described that is adapted to hold a plurality of tools, such as drills, screwdriver bits, countersinks, and the like and to hold a selected one of the tools in operative position. A further object is to provide a magazine brace that is of simple construction and operation.

SAFETY RAZOR.—J. W. FISCHER, 181 Schermerhorn St., Brooklyn, N. Y. Among the objects of the invention is to provide a safety razor arranged to permit of conveniently opening it for cleaning after a shave and for inserting the blade, and to permit of holding the blade in position under tension for either an ordinary shave or a close shave.

MICROMETER GAGE OR CALIPER.—A. HETHERINGTON, Tyron and Bryant Aves., Floral Park, L. I., N. Y. The object of this invention is to provide means in micrometer gages or calipers whereby the micrometer mechanisms are arranged for interchangeable use with U-shaped frames of different spans to provide a large range of measurement without requiring a number of different micrometers for measuring articles of different sizes.

UNIVERSAL CONCAVE SHAVE.—G. INGELSON, 4010 Joy St., Indiana Harbor, Ind. The invention has for its object to provide a shave having a cutting blade adapted for trimming and finishing concave and curved surfaces, and having a handle normally positioned at right angles to the cutting blade, and means for guiding the shavings cut from the work away from the cutting blade and out of position to interfere with further operations of the device.

ATTACHMENT FOR PRUNING SHEARS.—A. RAUSSE, Box 72, Northvale, N. J. The general object of the invention is to provide simple and efficient fastening means for use in connection with tools of the scissors type. The object is accomplished by providing on one handle of the tool latch means, and on the other, means capable of being engaged by the latch means, and associating with the latch means means for normally retaining the latch in an active position when the tool is being operated.

SHARPENING DEVICE.—E. E. ROGERS, 105 14th St., College Point, N. Y. Among the objects of the invention is the construction of a sharpening device by means of which knives may quickly have an edge formed upon their blade, this edge being formed without the aid of any mechanical members, and which, in addition to being capable of placing a cutting edge upon a knife, will also form a proper cutting edge upon a pair of shears.

REINFORCEMENT FOR PICK HANDLES.—G. G. DUPLER, R. No. 4, Box 34, Nelsonville, Ohio. The invention has for its object to provide a wire wrapping for pick handles adjacent the pick which will protect the same against being mutilated and also greatly strengthen this portion of the handle. The wire wrapping is so bound on that it can in no way loosen from the handle.

PLIERS.—H. H. JONES, 417½ So. Main St., Los Angeles, Cal. An important object of the invention is to provide a pair of pliers having means whereby the jaws may be securely held in engagement with a tool such as the shank of a screw-driver, a bit or the like. A further object is to provide pliers having a compartment secured to the inner side of the handle in which a variety of tools may be carried.

CLOSURE FASTENER.—H. VENTRE, 1680 Nelson Ave., New York, N. Y. One of the primary objects of this invention is to provide a closure fastener which is so constructed as to prevent a springing of the door and jamb relatively one to the other in a manner commonly known as "jimmying." A further object is to provide a closure which may be operated from the inside without the use of a key and from the outside by the use of a key.

Heating and Lighting

BURNER.—R. A. GRIM, 954 19th Ave. N., Seattle, Wash. The invention relates to oil burners especially adapted for use with domestic oil cook stoves. The object is to provide a burner wherein the fuel oil is vaporized, and the air preheated and mixed with the vaporized oil to obtain a proper mixture, which is completely consumed to generate a maximum amount of heat, and the heat efficiently radiated over a relatively large area.

COOKING RETORT.—F. B. DONNELLAN, 106 6th St., San Francisco, Calif. The invention relates to cooking retorts for cans generally and more specifically to those retorts in which the cans are heated by steam under compression, the particular object being to insert the cans into the retort in such a manner that very little steam is lost during the operation, and to in a similar manner cause the cans to leave the retort without any appreciable loss of steam.

MIRROR AND LIGHTING MEANS THEREFOR.—N. and M. SLOANE, 228 Roebling St., Brooklyn, N. Y. This invention is intended more particularly for use in association with small hand mirrors of the type carried in vanity bags, and has for its general object to provide an assemblage involving few and simple parts whereby to provide for the electrical illumination of the mirror.

KILN WITH HEATING CHAMBER AND COOLING CHAMBER.—V. GELPKE, Luzern, Reckenbühlstr 2, Switzerland. The principal feature of the invention is to provide compensating means to prevent the expansion or extension of the heating chamber from being transmitted to the cooling chamber, to the extent of damaging the cooling chamber.

HYDROCARBON-GAS GENERATOR AND BURNER.—H. C. SILLETT, 415 Olive St., Kansas City, Mo. The invention relates to burners for crude oil. One of the foremost objects is to provide a burner system which comprises a hydro-carbon gas generator, burner, means whereby the crude oil which is employed may be instantane-

ously lighted. A further object is to provide a multiple unit burner whereby all the units with the exception of one can be disconnected, so that only one burner need be used when required.

STEAM TRAP.—G. A. MOLIQUE, c/o Roxana Pet. Corp., Wood River, Ill. An important object of this invention is to provide a steam trap adapted for use in connection with a system of steam pipes, having means whereby the discharge valve of the same is automatically and quickly operated to expel the water upon being condensed, but which when seated will effectively prevent the leakage of the condensed steam.

Machines and Mechanical Devices

THRASHING MACHINE.—E. BOE, c/o I. D. Kretzer, M. St. P. & S. S. M. R. R., Clearbrook,, Minn. An object is to provide in a thrashing machine a quick means of thrashing the unthrashed grain that has fallen into the sieve. A further object is to provide means for automatically ejecting any foreign substance that may be carried with the grain, thus reducing to a minimum the breaking of any of the parts of the machine.

KEYWAY LOCATOR.—K. W. COUSE, 58 W. 57th St., New York, N. Y. The object is to provide a keyway locator by means of which two different elements may be centered, and which is capable of being used by an unskilled mechanic. The device includes a pair of calipers rockingly secured together, and an indicating means arranged adjacent the point of connection of said calipers for indicating the relative position of the calipers with respect to each other.

DEMOUNTABLE HEADSTOCK FOR LATHES.—A. L. LIGON, Box 447, Fort Stockton, Texas. An important object of the invention is to provide a headstock which is attachable to any of the ordinary types of small or large lathes, it being especially constructed to enable the taking of drill stems or other work which would otherwise be far too large and cumbersome for the lathe to take.

WASHING MACHINE.—A. SORENSEN, 1932 Irving Place, Oakland, Calif. This invention has for its object to provide a motor driven washing machine that can be conveniently used in combination with the ordinary wash tub, so that the water can be run into it directly from the faucet, and the dirty water dumped out by merely turning the machine upside down into the tub. The machine can be easily attached without tools, the only fastening means being thumb-screws.

TUBING BLEEDER.—G. C. IRONS and A. LARSON, Route 6, Box 21, Bakersfield, Calif. This invention is particularly designed to be used in connection with deep well pumps, as, for instance, oil pumps. Its object is to provide a mechanism whereby the oil or fluid collected in the pump tubing above the liquid lifting means can be drained out of the same directly through an opening in the tubing.

CONCENTRATING TABLE AND METHOD.—V. F. NEWMAN and M. W. LOOMIS, address V. F. Newman, Ward, Colo. The general objects of the invention are to provide a concentrating table whereby to embody certain features to cause the table to concentrate and save not only the coarsely ground particles of the valuable portion of ores but also save, to the maximum extent, the fine particles of the values or "slimes" as they are generally termed. The object is to effect the concentration by hydraulic settling.

SUPPORT AND CUTTER.—H. M. THOMAS and M. FOGEL, 255 W. 84th St., New York, N. Y. The invention relates to a support and cutter to be associated therewith. It primarily aims to provide a device which shall be capable of being readily associated with a roll of material and hold the same by suitable clamping elements. The cutting means consist of rotatable blades mounted upon supporting elements and adapted to be mounted longitudinal of the material.

AUTOMATIC STOP FOR MOVING PICTURE MACHINES.—J. B. KUHN, Cameron, W. Va. An important object of this invention is to provide an automatic stop having means whereby the machine is stopped when the film fails to feed by the feed sprockets when the film is prevented from being entirely broken. The object is to provide mechanism which will reduce fire hazards, in that the machine is stopped before the film can catch fire.

ORE-SEPARATING DEVICE.—W. S. BROWN, c/o Wallace Hospital, Wallace, Idaho. The invention has for its object to provide an ore separating device in the nature of the jig, by means of which a series of sizes of ore may be worked simultaneously and wherein the length of the stroke of the jig may be lengthened or shortened. A further object is to provide a form of cup for use with the jig, to assist in and facilitate separation of ores.

PUMP.—E. C. CUMMINGS, Electra, Texas. The general object of the invention is the provision of a pump for use in oil wells, having means for protecting the barrel value from being sanded, means for preventing the flow of sand into the upper end of the barrel, and means for allowing for displacement of the liquid between the plunger and the means for preventing the flow of sand into the upper end of the barrel.

CONNECTING ROD.—F. A. DREHER, 214 Railroad Ave., Dover, Ohio. The invention relates to connecting rods especially adopted for use on stationary engines, traction engines, locomotives, steam shovels, hoists and the like. An important object is to provide a connecting rod for steam engines having means whereby the bearings may be readily and conveniently removed or applied.

ATTACHMENT FOR SPINDLE BEARINGS.—R. H. HUGHEY, 807 Kitson St., Greenwood, S. C. The object of the invention is to provide an attachment for spindle bearings of the type employed for rotatably supporting one end of a bobbin spindle, such as are used in spinning machinery, by which broken bearings may be quickly and easily repaired and when so repaired will serve to prevent the belt from rising on the bobbin of yarn. The attachment may be applied to unbroken bearings and serve as a preventative of possible breakage.

AUTOMATIC FEED DEVICE FOR PEARLING CONES.—F. E. GIOZZA, Queydan, La. The invention relates generally to machines for scouring or pearling rice, oats and the like. More particularly the invention aims to provide means for feeding grain to the rim of a pearling cone instead of to the center, and providing for a free, unobstructed feed under proper working conditions and an automatic check of feed when the level of grain exceeds a desired point.

PROPELLER.—G. A. OGRISSEK, 189 Delaware Ave., Jersey City, N. J. An object is to provide a propeller construction wherein efficient results are secured either in the air or in water, the blade having a gradual change of angle of pitch throughout its length, whereby an even pull or push is produced. A further object is to provide a construction in which vibration is eliminated, and in which the blades may be formed somewhat corrugated for engaging in a better manner the air or water.

SHEAVE BLOCK.—D. G. MANGES, c/o U. S. Steel Block Corp., 96 Liberty St., New York, N. Y. The invention has for its object to provide a sheave block having a mounting for the wheel arranged to wear uniformly. A further object is to provide interchangeable wear plates which may be detached when worn and replaced by new plates, arranged at the points engaged by the cable when the block is in use.

DRILLING MACHINE.—A. L. EDWARDS, Maupin, Oregon. An important object of the invention is to provide a pitman rod or power transmitting mechanism for a drilling machine, having means to relieve the machine of excessive strain due to the striking of the drilling mechanism in the hole. A further object is to provide a pitman rod which may be efficiently applied to various types of drilling machines, and which is comparatively cheap to manufacture.

WOOD SPLITTING MACHINE.—A. R. TREAT, Eagle Lake, Minn. The invention has for its object to provide means whereby the axe or splitting member may be elevated and subsequently released so as to drop by force of gravity on the wood and thereby split the same. A further object is to cushion the blow so that the machine may not be unnecessarily strained.

AUTOMATIC BOILER FEED.—J. S. LEE, 829 E. 7th St., N., Newton, Iowa. The invention relates to feed mechanism for supplying water to boilers while in action, the particular object being to render the feed entirely automatic, the mechanism being so constructed and arranged as to control with great nicety the amount of water contained in the boiler.

WELL PUMP.—J. PENROD and R. D. THOMPSON, 1241 E. 9th St., Okmulgee, Okla. More particularly the invention is designed for use in connection with oil wells where the presence of sand usually renders it necessary to frequently replace valve seat and pump leathers. The prime object is to provide a pump which may be placed within the casing of a well without the necessity of a pump tube and which may be adapted in place at any desired point within the well casing and clutched at that point until its removal becomes essential.

FILM SPROCKET WHEEL FOR MOVING PICTURE MACHINES.—H. B. BYRON, c/o H. Ayr Co., 359 E. 155th St., Bronx, N. Y. The invention relates to mechanism for the taking, printing, or projecting of moving pictures. An object resides in the provision of a sprocket wheel construction and arrangement which effectively cope with the problem of register, and to prevent injury to film by the "backing up" or crowding of the same, and which does not materially increase the cost of production of the machine, and is thoroughly reliable and highly efficient in its purpose.

VALVE FOR OIL SYSTEMS.—N. DU-BOIS WHITNEY, Naugabuck Ave., Walnut Beach, Conn. The primary object of the invention is to provide a form of valve especially adapted for use in the fuel lines of oil burners. A further object is to provide a device in which fine adjustment of the valve may be had, and operating mechanism which may be retained in its adjusted position against accidental displacement. (See Fig. 8.)

HOIST.—L. and F. PIGNANI, c/o Sam W. Miller, First National Bank Bldg., Blairsville, Pa. The object of the invention is to provide a hoist which is simple and reliable in operation; which gives a proper lead to the cable or cables; which is so constructed as not to be liable to injury by virtue of the cables becoming entangled with the mechanism; which is easily controlled by the operator without the necessity of his assuming a dangerous relation with respect to the moving parts; and which is easily transported from place to place. (See Fig. 9.)

MACHINE FOR CUTTING BEVEL-GEAR WHEELS WITH HELICAL OR STRAIGHT TEETH.—V. G. DARTOIS, 4 Boulevard Melesherbes, Paris, France. This device is characterized by the fact that the planning tools are spaced from the surface to be worked by a displacement at right angles to the surface, said displacement being obtained by a bent lever having a limited angular stroke and controlled by the main driving link, which cannot drive the tools in their return stroke before spacing them, nor drive them in their forward stroke without having determined the restoration of their adjustment in depth.

TYPEWRITER ATTACHMENT.—W. J. IWAMI, 611-621 Broadway, New York, N. Y. The aim of the invention is to provide a typewriter attachment by means of which the type of a typewriter machine may be thoroughly and quickly cleaned without the necessity of soiling the fingers. A further object is to provide an attachment of this nature which may be placed upon the market at a nominal figure.

VALVE HANDWHEEL.—F. R. BANKS, c/o McNab & Harlin Mfg. Co., N. E. corner John and William Sts., New York, N. Y. An object is to provide a valve handwheel of about the same size and general shape of the gate valve handwheels now generally used, but with radial sockets open at the peripheral face of the rim for the insertion of a leverage extension member with which to turn the wheel, thus avoiding very large and heavy handwheels in order to obtain the desired leverage.

DOWEL-MAKING MACHINE.—G. W. DAVIS, Keene, N. H. The invention relates to means for forming circular rods from stock which is square or irregular in cross section. The machine is so constructed that in case of breakage of stock in the cutting head, the stock may be easily removed. The cutting knives are held in a support in such manner that they may be resharpened, and may be used until they are completely worn out.

LATHE ATTACHMENT.—J. V. DILLEY, Room 410, Sun Bldg., Detroit, Mich. This invention refers more particularly to lathes used in connection with the manufacture and repair of watches and jewelry. An object is to provide a strong bracket upon which to support small motors to run the lathe, and which can be very easily attached to the lathe frame, so as to support the motor without vibration.

FINGER PIECE.—J. S. POPPER, 21 Claremont Ave., New York, N. Y. The invention relates to dials of machine-switching telephones. Its object is to provide tubular finger pieces mounted on a finger wheel to enable the user to readily turn the dial to stop positions without danger of rendering the tip of the actuating finger callous with the required repeated turning of the dial. Another object is to permit of readily applying the finger piece to dials as now generally constructed.

HOISTING DEVICE.—M. D. POTTER (deceased), address A. M. Freeman, 735 1st Ave., S., Sioux Falls, S. D. This invention aims to provide a hoisting device for barrels having means whereby the barrels may be hoisted to a point from where it is convenient to discharge the contents of the same, without losing any of the liquid. A further object is to provide simple means whereby the barrel may be tilted to a horizontal position upon being elevated.

DELIVERY-WHEEL TRIP FOR FEEDERS.—P. GITZENDANNER and F. J. ALBERT, 300 12th St., West New York, N. J. An object of the invention contemplates a trip for the idler delivery wheels of the feeder of a printing press folding machine, which trip is actuated by the throw-off mechanism to positively prevent further feeding of the sheets by the momentum of the feeder mechanism whereby to effect a saving of the sheets as well as to prevent undue clogging of the feeder and the time and trouble incident to the removal of the sheets which become clogged.

LATHE.—W. BUTTRUM, c/o Union Iron Works, E. 7th St., Joplin, Mo. The invention relates more particularly to an attachment for lathes to facilitate the carrying out of various thread-cutting operations. An object is to provide an attachment which adapts the conventional or standard lathe to carry out the accurate cutting of threads of various pitches of standard or special design, with a minimum expenditure of time, and without impairing the original capacity of the lathe.

HARNESS RETRACTOR.—A. H. LANDRY, 8 Western Ave., Lowell, Mass. The invention relates to a harness evener or retractor adapted for use in connection with looms, by means of which it will be possible by a simple manipulation of the parts, to properly even and retract the harness, to more quickly locate the heddle, and properly insert the thread subsequent to which the harness may be instantly returned to its normal position.

MOTOR STAND.—C. V. FISHER, 810 W. No. St., Muncie, Ind. This invention has for its object to provide a stand of the character specified especially adapted for supporting a motor during testing or repairs, wherein the stand is adjustable and capable of being secured in an adjusted position, and

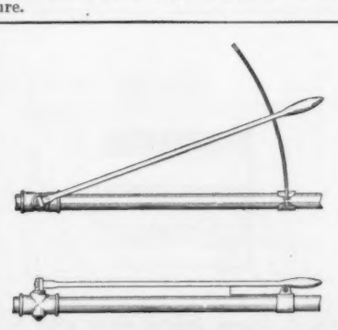


Fig. 8: Valve for oil-fuel lines, invented by N. Du B. Whitney

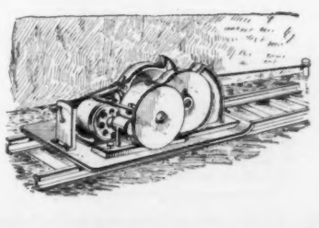


Fig. 9: Compact and powerful hoist patented by L. & F. Pignani

is provided with means for supporting the motor in any desired position.

COLLAPSIBLE EXPANSION GASKET.—L. FRIEDMAN and D. WALLACE, Kennedy Bldg., Tulsa, Okla. The invention relates generally to appliances for oil, gas or water wells, and particularly to a collapsible expansion gasket capable of use for other purposes where gaskets or packers are employed, the object being to provide a gasket permitted to readily collapse on withdrawal from the well so as to eliminate trouble experienced in pulling or withdrawing well packers.

Medical Devices

MEDICAL APPARATUS FOR USE IN PROCTOTHERAPY.—O. B. SCHELLBERG, 24 E. 48th St., New York, N. Y. The invention pertains more particularly to apparatus for treating diseases and infections of the colon and alimentary canal. The primary object is to provide apparatus which will serve to remove intestinal flora and feces from the colon, and at the same time provide a device by means of which antiseptics may be applied.

CLAMP.—G. M. DEANE, 1016½ Elm St., Dallas, Texas. The invention has for its object to provide a device especially adapted for use by chiropractics in the treatment of spinal troubles for adjusting the vertebra with respect to each other. The device consists of gripping jaws for engaging opposite sides of the spinal column, these jaws being pressed toward each other to move the displaced vertebra into place.

Musical Devices

RECORD DISK.—F. LENTON, 16 East 23rd St., New York, N. Y. The invention relates to disk records for graphophones, and seeks for its principal object to provide a simple means for facilitating the application of the record to the turntable of the machine, and to insure the proper centering of the record. The device does not add to the expense of manufacture or necessitate any alteration to the graphophone.

BANJO.—R. A. CABUCCI, c/o Oscar Schmidt, Ferry St., Jersey City, N. J. The object of the invention is to provide a banjo arranged to increase the tonal qualities both as to volume and resonance. Another object is to permit of conveniently and quickly adjusting the neck of the banjo relative to the body with a view to maintain the strings in the desired and correct position relative to the frets on the neck.

DISK RECORD CONTAINER FOR PHONOGRAPHS.—A. G. BLOCKER, 4921 Ashby Ave., St. Louis, Mo. Among the objects is to provide a container adapted to be mounted in an ordinary phonograph of the cabinet type construction, and adapted to receive a relatively large number of records. It is also an object that the disk records be supported in such manner that they will not be scratched or broken, and may be easily removed from or positioned in the container.

PHONOGRAPH.—S. J. ROGNLIE, Lewistown, Mont. The invention has for its object to provide mechanism for connection with a phonograph of any character, for providing a greater variety of tone, wherein, in addition to the main horn, there is an auxiliary trumpet horn opening at the back of the cabinet, to produce a distant trumpet effect.

BANJO STRUCTURE.—C. PARKER, Keene, N. H. An object of the invention is to provide a banjo structure in which by the provision of a simple arrangement of parts, the quality and volume of the tine may be increased and varied at will. A still further object is to so construct the rim and sounding board that the sounding chamber is made practically moisture proof.

MOISTURE-ABSORBING DEVICE.—J. A. HAMLIN, 204 W. 80th St., New York, N. Y. The general object of the invention is to provide a device adapted to be placed within a piano or within cases of other musical instruments, or in a closet, said device to be so formed and charged with material having an affinity for moisture, that it will be efficient in maintaining the humidity at such low degree as to prevent the binding of keys of an instrument, or other abnormal conditions, due to the presence of moisture.

Prime Movers and Their Accessories

ROTARY STEAM ENGINE.—C. O. BANER, 70 Webster St., San Francisco, Calif. The primary object of the invention is to provide a slow-speed rotary steam engine. Another object is to provide an engine which will do away with gearing and other unnecessary parts, and to employ a plurality of stages in which the steam is used and thus derive a maximum efficiency from any given quantity of steam.

ATTACHMENT PLUG FOR OILING SYSTEMS FOR INTERNAL COMBUSTION ENGINES.—R. W. SAUNDERS,, 1108 Lincoln Place, Brooklyn, N. Y. Among the objects of the invention are to provide a plug adapted to be used for facilitating the blowing out or cleaning of the interior of pipes or conduits employed in oiling systems for internal combustion engines or the like; it is also an object that the plug be adapted to be easily attached or positioned in connection with the compressed air supply.

INTERNAL COMBUSTION ENGINE.—A. E. NICHOLLS, Wilson Creek, Wash. The aim of this invention is to provide means whereby the flow of oil to the end crank shaft and connecting rod bearings of an internal combustion engine is automatically regulated and controlled by the position of the motor, and in accordance with this invention the forward crank shaft and connecting rod bearings are provided with an increased flow of oil when the motor is ascending a hill; the system does not interfere with the supply of oil when the motor is arranged horizontally.

SPARK PLUG.—C. T. ROTH and E. P. NICHOLSON, c/o The Roth Cloth Co., 1152 Monadnock Bldg., Chicago, Ill. The invention relates to a spark plug which primarily will present such a construction as to be capable of being readily cleaned. Another object is the construction of a plug which shall practically eliminate "leakage," and in which a certain visible signal is associated in a series with the plug whereby the operation of the same may be instantly noted.

VALVE LIFTER.—R. T. SHIBIYA, 5371 N. 27th Ave., Omaha, Neb. An object of the invention is the provision of a simple and efficient device which can be readily applied to an internal combustion engine in the smallest possible space to effect the removal of the proppet valves therefrom. Another object is to provide a device which can be adjusted for different-sized engines in a very easy manner.

SPARK PLUG.—J. MALLIGAN, Port Marion, Pa. The invention relates more particularly to a construction and means whereby the spray or moisture of the gaseous fuel, as well as excess oil when compressed against the spark will be effectively broken up so as to insure better ignition and more positive action, as well as resulting in a spark plug thoroughly cleaned and maintained in efficient condition for a long period.

COMMUTATOR.—G. E. COOK, c/o Powell, 198 Montauk Ave., Brooklyn, N. Y. The object of the invention is to provide a commutator or timer more especially designed for use in the ignition system of internal combustion engines of the multiple cylinder type and arranged to reduce the chance of missing to a minimum. Another object is to prevent burning out of the circuit wires, to prevent short circuiting and exclude dust or other extraneous matter liable to affect the proper functioning of the commutator.

INTERNAL-COMBUSTION ENGINE.—C. R. PRYOR, 2830 Robinwood Ave., Toledo, Ohio. An object is to provide a construction of engine having a rotary cam member operated by a circular series of double-acting pistons, each piston movable in a pair of alined cylinders receiving impulses in both. A further object is to provide a construction of two-cycle double-acting engine, whereby the reciprocating cylinders serve to impart motion to a rotary member and also compress the gas and eject the same after an explosion. (See Fig. 10.)

Railways and Their Accessories

RAIL-FASTENING MEANS.—S. B. KULL, c/o Warner, 1050 Bergen St., Brooklyn, N. Y. The invention relates to means whereby spikes used in connection with railroad rails are effectively fastened down in cooperation with the rail. An object resides in the provision of means whereby the rail and the spikes can be assembled in place and fastened in position in much less time, whereby a saving of time and labor is achieved.

ALINING INSTRUMENT FOR CROSSHEAD GUIDE BARS.—A. R. BATEMAN, 1219 Garfield Ave., Lynchburg, Va. The invention relates to locomotives or other forms of steam engines having detachable cross head guide bars associated with the cylinders. A purpose is to provide an instrument adapted to be applied to the engine cylinder for alining the cross head guide bar with respect to the axis of the cylinder, the device is easily applied and operated.

BRAKE ROD ADJUSTER.—R. C. MCARTHUR, address A. A. Krieger, Attorney, 33 Main St., Salamanca, N. Y. An object of the invention is to provide a turn-buckle connection involving a turn-buckle rod oppositely threaded at its ends and normally adjusted and clamped within socket members, the latter of which in particular are so formed as to permit of ready adjustment when the clamping means are released. A further object is to avoid the use of lock nuts and provide against the collection of dirt, rust and the like between the threadedly engaged portions.

SWITCH-HEATER COVER.—W. T. LAWLOR, 68 Wayne St., Jersey City, N. J. The invention relates to pan covers for oil pans, located under the rails of a switch mechanism, and in which oil is burned to keep the switches open during heavy snow storms. An object being to provide a cover which will effectively prevent snow from falling into the pan, and at the same time will prevent a burning of the oil therein.

BOX-CAR DOOR.—O. FROMAN and W. A. WILMOTH, c/o Edna Mutual Telephone Co., Edna, Kansas. An important object of the invention is to provide a grain car door having a plurality of sections, which may be placed in position as the car is loaded and which when in position absolutely prevent the escape of grain. A further object is to provide a door which is simple to operate, and having means whereby grain may be discharged when desired without removing the sections. (See Fig. 11.)

DIRIGIBLE HEADLIGHT.—H. E. BEASLEY and W. BYRD, 943 St. Charles St., Victoria, B. C., Canada. This patented structure mounts a locomotive headlight on a turntable operated by a piston held central in a controlling cylinder by springs and operated by air under pressure, the escape and admission of the air being controlled by valves subject to fingers on the truck.

AUTOMATIC TRAIN-STOPPING DEVICE.—R. B. BOYLE, 4262 Jefferson St., Kansas City, Mo. An object of the invention is to provide a device by means of which the stopping of trains may be accomplished automatically, either from the train dispatcher's office or by a flagman. A further object is to provide a device in which the air in the main brake line is released by the positive opening of the line, when cooperating apparatus has been set by either the dispatcher or the flagman.

RAIL JOINT.—J. B. MURRAY, Wilmington, Ill. Among the objects of the invention is to provide a rail joint in which an upward pressure is exerted on the rail ends which is equal to the weight of the train wheel passing thereover, the support being adjustable distributes the weight of the train wheel passing over the rail ends to other portions of the rail. The device is simple in construction and can be readily assembled.

CAR JOURNAL.—A. MELVILLE, Morrisville, Pa. This invention relates to railway rolling stock. One of the primary objects is to so construct the brass of a journal box that the same will under normal conditions have its opposite ends in operative engagement with their respective ends of the axle journal, thus reducing the tendency of the car body to sway sidewise in its travel.

TROLLEY HARP.—J. G. VINSON, Graham, Ky. The invention particularly relates to the manner of mounting the trolley wheel and of collecting the current. The general object is to provide a trolley in which the wheel is so mounted on the trolley pole that the upward pressure of the pole is efficiently applied to return the wheel in engagement with the trolley wire. A further object is to provide for collecting the current through the medium of a brush without relying upon the trolley wheel.

Pertaining to Recreation

BASEBALL TARGET.—E. C. SHEARS, 454 Jefferson St., Portland, Oregon. The general object of the invention is to provide a target with an opening through which a baseball may pass, and a swinging element thereon, having means appurtenant thereto to automatically restore the target to normal position and to limit the movements of the target rearwardly in response to the ball and forwardly in the restoring of the target.

AMUSEMENT DEVICE.—J. M. REALING, 220 So. Palmetto Ave., Dayton, Fla. The invention has for its object to provide a turntable upon which children may be seated and also to provide means by which the table may be propelled by the children carried thereon in an easy manner. A further object of the invention is that the device be simple, and safe in every manner for children of minor years to operate.

BUMPER.—J. J. STOCK, 2629 N. Reese St., Philadelphia, Pa. The invention relates to a bumper primarily adapted for use in connection with amusement vehicles, but is not necessarily limited to use in this connection, and by means of which an element will be presented which may readily be associated with a vehicle, and which will further be capable of withstanding a great amount of usage and will at all times effectively cushion shocks.

BUFFER FOR AMUSEMENT CAR.—C. F. STILLMAN, 955 Angelique St., North Bergen, N. J. The invention relates to amusement apparatus and particularly to a buffer construction for use in connection with a passenger car. An object is to provide an arrangement of tension springs which operate to support and maintain the annulus or buffer ring in a predetermined and positive horizontal plane parallel to the bottom of the car body.

AMUSEMENT DEVICE.—E. J. MAYER, address Jos. Schneps, 614 W. 157th St., New York, N. Y. One of the primary objects of the invention is to construct an amusement device in such manner that a plurality of passenger cars are carried around a circular track, the surface of which is of an undulating character and that the passenger-carrying elements will have pivotal movement in both the direction of and the direction opposite to the circular direction of travel.

AMUSEMENT RIDE.—J. IRSCH, c/o M. Fleckenstein, 253 13th Ave., Long Island City, N. Y. This invention has for an object to provide means which will give the varying sensation of riding up hill and down hill at different speeds. Another object is to provide an amusement device wherein the car is projected over a given path from a source of power and caused to move back automatically to the point of starting.

TOY.—L. MARTOCCI-PISCULLI, 235 2nd Ave., New York, N. Y. The invention aims to produce a toy which will result in the moving of an inanimate object, as in the commonly-known "ouija board." The players place their fingers in such position on the device that the apparatus will show a tendency to turn, and rotation of the entire apparatus will be continued until a magnetic needle, registering with an indicating mark, answers the question asked.

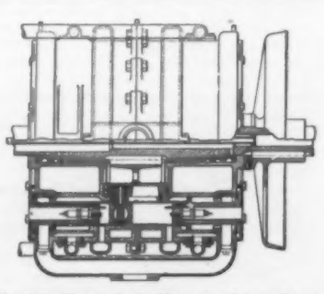


Fig. 10: Tyo-cycle double-acting internal-combustion engine, the design of C. R. Pryor

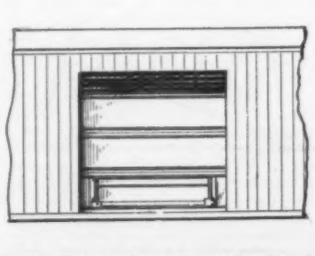


Fig. 11: Box-car door, of special utility in connection with grain shipments, invented by O. Froman and W. A. Wilmoth

MECHANICAL TOY OPERATED BY GRAMOPHONES.—H. J. HASTINGS and C. ST. V. SMITH, 28 St. Stephen's Gardens, East Twickenham, England. The invention relates to a mechanical toy representing dancing figures for use with a phonograph, and comprises a revoluble spindle for carrying the toy, a floating disk loosely mounted on the spindle so as to tilt, and adapted to engage the turntable of a phonograph, and means on the spindle and cooperating with the tilted disk to rotate the spindle.

GAME.—J. W. FISCHER, 181 Schermerhorn St., Brooklyn, N. Y. This invention relates to parlor games. Its object is to provide a game arranged to permit two or more persons to play the game. The game comprises a game board and members adapted to be moved over it. It requires but little space on a table or other support, and affords considerable amusement to both players and onlookers.

TOY AIRSHIP.—B. B. KEITH, Mansfield, Ohio. An object of the invention is to provide a toy which will simulate an airship of the dirigible type, and which can be manufactured and sold at an extremely low price. The device can be sold in knockdown form, the several parts being conveniently packed in an envelope, and be readily assembled by anyone of average intelligence. It is ornamental and attractive.

Pertaining to Vehicles

AUTOMOBILE ATTACHMENT.—P. J. RIDENOUR, Box 578, Silver City, N. M. The object of this invention is to provide for automobiles an attachment that will show to the public and police the make of the car and the license number of the same, both being inter-related in such manner that neither can be changed without breaking or affecting the other, and being so connected with the parking and tail lights that the removal of the device will turn out both lights, thereby attracting the attention of the police. (See Fig. 12.)

LOCKING DEVICE FOR AUTOMOBILES.—J. P. GERAGHTY, 493 Grove St., Jersey City, N. J. The object is to provide a locking device for automobiles and similar power-driven vehicles, and arranged to prevent unauthorized persons from starting and running the motor, thereby preventing theft. Another object is to permit of readily applying the device to different types of automobiles, and manipulating the locking and unlocking of the same.

DIRECTION INDICATOR. — W. J. SCHAFER, 103 Van Ness Ave., Santa Cruz, Cal. The invention has for its object to produce a device that will enable the driver of an automobile to indicate to persons behind his machine whether he intends to stop, to turn to the right or left, or to go straight ahead. A further object is to provide a device which is simple, purely mechanical, and operated directly by the hand of the driver.

SAFETY STEEL STRAP CUSHION LOCK.—R. W. SAUNDERS, 1108 Lincoln Place, Brooklyn, N. Y. The object of the invention is to provide a protection against thievery of tools and other goods carried under the cushion seats. The device comprises a fabric-covered longitudinal substantially flat metal band, a hinged attachment to the band at one end and a lock element attached at the other end adapted to engage a cooperating lock element.

TIRE CASING.—D. MORIARTY, 10009 E. 14th St., Oakland, Calif. The specific object of the invention is to provide a tread member which will be especially adapted to withstand high pressure and render the tire practically immune from puncture. This casing comprises an inner member of fabric material, a rubber tread, rigid members secured in the fabric extending into the rubber, and reinforcing wires between the rigid members within the rubber.

GREASE RETAINER.—S. B. COLLIER, 503 Mariposa St., Orlando, Fla. The invention relates to oil retainers of the character ordinarily used on rear axles of automobiles, the primary object is to provide a retainer which will positively prevent oil from the differential housing from leaking into the brake drum, and which can be applied to the axles of certain well-known types of cars without altering the construction or greatly increasing the cost of manufacture.

MAXIMUM PRESSURE-INFLATING VALVE AND GAGE.—S. B. NOE, 3711 Eliss Ave., Chicago, Ill. The invention relates to the inflation of pneumatic tires, and has particular reference to a combined maximum pressure-inflating valve and pressure gage therefor, and contemplates the provision of a device which is designed for permanent association with a pneumatic tire for effecting the inflation, for gaging the pressure, and for automatically discharging excess pressure above a predetermined degree.

SPRING SUSPENSION.—V. W. PAGE, c/o Page Motor Co., Melrose Ave., Stamford, Conn. It is an object of the invention to provide in combination with the front axle of a vehicle two independent springs for supporting the chassis, one of which springs forms a lever for transmitting the weight to the other until such time when the second spring element will be prevented from acting, at which time the first spring element serves to function to resiliently support the load of the chassis.

GASOLINE-ELECTRIC AUTOMOBILE. F. G. LE MERLE, M. J. ULLMAN and J. E. BARRY, 14444 W St., N. W., Washington, D. C. Among the objects of the invention is to provide a power plant embodying an internal combustion engine and an electric generator, the latter being so wound that it may be operated as a starting motor for the engine. A further object is to provide a power plant in which is incorporated a governor which causes the vehicle to travel at a uniform speed, after a proper adjustment has been made, regardless of whether the vehicle is traveling a level stretch or an incline.

SPRING GUARD FOR VEHICLES.—L. H. B. HAND, 15332 Lexington Ave., Harvey, Ill. An object is to provide a guard which is constructed in such manner as to be capable of maximum range of movement under stress for a guard of a given size without rupture or permanent set, yet will dissipate shocks and jars without communicating the same to a supporting vehicle frame. The device may be applied to or dismounted from an automobile in a minimum of time, with the use of ordinary tools.

TRANSMISSION GEAR.—L. J. MOBLEY and A. V. HAYS, 923 South Broadway, Springfield, Mo. The general object of the invention is to produce a transmission gear in which the gear elements, provided on the clutch shaft for different speeds, are in constant mesh with the corresponding gear elements on the driven shaft, and in which clutch pins are readily disposed and optionally operable to be caused to selectively lock to the propeller shaft the desired gear element for a particular speed or reverse.

RESILIENT TIRE.—R. CURRY, 540 E. 183d St., Bronx, N. Y. The invention refers more particularly to non-pneumatic resilient tires for vehicle wheels. Broadly, the invention contemplates a tire which affords the same cushioning effect as a pneumatic tire, but which eliminates the objections thereto due to punctures, blow-outs or the like. The wheel comprises inner and outer rim members, and a plurality of spaced pairs of wedge blocks for resisting the relative movements of the rim members.

MULTIPLE RIM RESILIENT WHEEL. H. MCDERMOTT, 336 W. 4th St., Leadville, Colo. An object of the invention is to provide an all-metal wheel that is sufficiently resilient for practical application to automobiles, tractors, and other vehicles. A further object is to provide a device having a single hub and a plurality of rims arranged eccentrically, whereby corresponding portions of the several rims contact the ground successively, and a vehicle can be propelled more readily over uneven surfaces with less tractive power.

LOCK FOR IGNITION CIRCUITS.—M. F. GIFFORD, R. 2, Newaygo, Mich. Among the objects of the invention are to provide a locking device for ignition circuits provided with means for breaking the circuit at the will of the operator and with means for preventing the reestablishment of the circuit thus broken until the last-named means are operated in a manner known only to the operator, thereby reducing the possibility of theft of the automobile since the car cannot be driven under its own power by anyone not possessed of the required knowledge.

LOW-PRESSURE ALARM FOR PNEUMATIC TIRES.—W. H. BROWN, 1277 N. Raymond Ave., Pasadena, Calif. The primary object of the invention is the provision of an arrangement which will operate between maximum and minimum pressures in such manner as to sound an alarm continuously between these pressures and automatically act to cut off communication between the tire and the alarm member when the minimum pressure has been reached, so as to prevent further escape of air from the tire.

FOLDING TENT BED FOR AUTOMOBILES.—E. TUTTLE, 118 E. 9th St., Grand Island, Neb. The invention relates more particularly to a folding bed having provision for the use of a covering or canopy, the object being the provision of a simple compact structure capable of being used and carried as a regular part of the equipment of an automobile without adding bulk to its appearance and without inconvenience to the passengers or operator in the normal use of the vehicle. The bed when in folded position has the appearance of a small body extension.

STEEL TIRE.—A. P. MALLON, 300 Baker St., San Francisco, Calif. This invention relates to tires for motor vehicles in general, its object is to provide a tire made of spring steel, spirally wound, or similar rigid material, and to arrange the units comprising the tire in such manner as to secure elasticity equivalent to that obtained by air cushions enclosed in pneumatic tubes. In order to obtain a still better cushioning a plurality of cushioning members are secured to the outer periphery of the tire. (See Fig. 13.)

PULLING DEVICE.—C. D. KRELL, 318 Thomas St., Jacksonville, Fla. The object of the invention is to provide a device adapted for use in extracting automobiles or the like from mud holes, ruts or the like. The device is extremely simple and of durable construction, adapted to be carried by the automobile, and to utilize the power of the automobile to effect the pulling thereof and which is reliable and safe in operation. (See Fig. 14.)

MUD SHOE.—G. O. BAIRD, Shreveport, La. The invention has for its object to provide a construction which may be readily applied or removed, the device acts to cause the driving wheel of an automobile to grip the ground and to form a vertical lift which increases during rotation. A further object is to provide a mud shoe wherein independent metallic boxes or frames are connected together by articulating means, so that they may conform to the shape of the tire. (See Fig. 15.)

TIRE CARRIER.—G. W. STEWART, Box 107, Loughman, Fla. An important object of the invention is to provide a tire carrier having means for supporting a tire in such a manner that the tire is prevented from chafing. A further object is to provide a carrier having a compartment which is automatically opened when the carrier is swung to open position, whereby the entire operating tools are simultaneously exposed for use.

WINTER INCLOSURE FOR AUTOMOBILES.—N. A. MICHNA, 3918 W. 26th St., Chicago, Ill. An object of the invention is to provide a winter inclosure for automobiles that can be easily and compactly packed for shipment. A further object is to provide a device that can be readily attached to an automobile without altering the construction of the latter, and that has hinged portions adjacent the doors which are adapted to open and close with the doors.

BRAKE DRUM.—V. W. PAGE, Melrose Ave., Stamford, Conn. The primary object of the invention is to construct a brake drum of relatively soft material and provide the same with a hardened lining adapted to take the wear and tear of the braking operation. It is a further object to attach the drum lining in such manner that the braking strain will be taken from the rivets employed in holding the lining in place.

ADJUSTABLE FOOT PEDAL.—V. W. PAGE, Melrose Ave., Stamford, Conn. An object of this invention is to so construct a foot lever that when the adjustments are made the several parts may be tightened to prevent rattling. A further object is to provide a foot lever in which both the angular position of the foot pedal relative to the lever and the distance of the foot pedal from the lever may be adjusted.

HEADLIGHT.—J. S. WHEELER, c/o U. S. Internal Revenue Office, Phoenix, Ariz. Among the objects of the invention is to provide a headlight which may be adjusted for projecting its light immediately before, or further forward of the automobile or vehicle with which it is associated. It is also an object to provide for diffusing the light in such manner that it will not have a blinding effect to drivers of oncoming vehicles.

FAN-PULLEY WHEEL AND CRANK RATCHET.—G. A. SLEIGHT, Hyde Park, N. Y. The invention relates to cranking mechanism for Ford automobiles and has for an object to provide a ratchet and fan wheel wherein an easy starting may be had through the use of a removable crank. Another object is to provide a starting ratchet for movable cranks whereby the crank acts as means for setting the starting mechanism and then actuating the same.

PERMUTATION LOCK FOR AUTOMOBILES.—A. P. LITREM, 48 Rue Crozatier, Paris, France. The invention relates particularly to a lock which is applicable to the steering gear of an automobile. The device is essentially characterized by a bolt carried by the outer tube of the steering gear, this bolt may be engaged in the tube or rod integral with the steering pillar and is

Fig. 12: P. J. Ridenour's idea for making automobile-stealing more hazardous

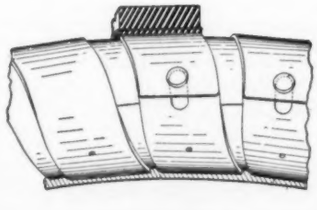


Fig. 13: Steel tire for automobiles, invented by A. P. Mallon

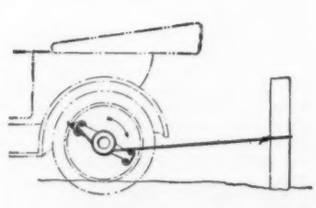


Fig. 14: Self-pulling device for getting the car out of the mud, patented by C. D. Krell

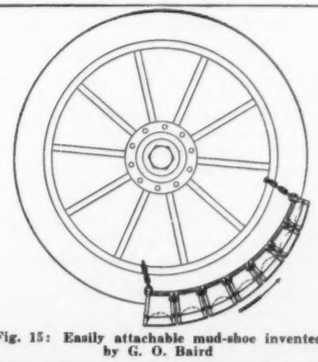


Fig. 15: Easily attachable mud-shoe invented by G. O. Baird

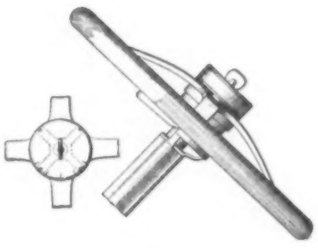


Fig. 16: Single-button headlight and signal swit h invented by R. R. Risk

Fig. 17: C. Taylor's shield for the protection of inner tubes from puncture

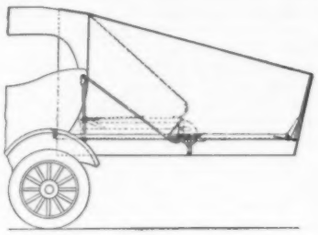


Fig. 18: Automobile bed patented by E. V. Loustalot

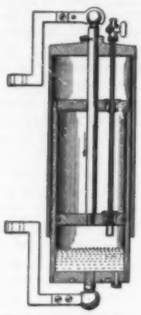


Fig. 19: Shock absorber of new design developed by E. S. Lehr

maintained in its locking position by a combination system, which may be altered at will, and which can only be released by one knowing the combination.

LOW PRESSURE ALARM FOR PNEUMATIC TIRES.—W. A. HARRIS, c/o Harris Accessory Co., Greenville, S. C. The primary object of the invention is to provide an air actuated signal member of both audible and a visible nature, together with means whereby to actuate the same in such manner as to expose the signal member to view, at the same time a signal is sounded and in this way serve to notify the operator that tire pressure is low.

BOW.—G. C. WELTER, Roswell, N. M. The invention relates particularly to a bow construction intended for use in connection with the supporting of coverings for motor vehicles, the bow being so constructed that no danger of the fabric becoming unduly worn adjacent its points of contact with the bow exists. A further object is to provide retaining means for the straps, by which the cover will be held without danger of the same becoming worn or torn.

SWITCH.—R. R. RISK, c/o Centenary College, Shreveport, La. The invention has for its object to provide a simple device especially adapted for use with motor vehicles. It is designed to be used for headlights, for signal system or rear fenders, and for varying the intensity or kind of illumination, so that the headlights may be used bright or dim. A single switch level or button regulating all. (See Fig. 16.)

TIRE CHAIN FASTENER.—C. L. KNOWLES, Kingsley, Iowa. An object of the invention is to provide a fastener by means of which an anti-skid chain may be quickly attached to an automobile with a minimum expenditure of time and labor. Another object is to so construct the fastener as to cause it to lock tighter as the speed of the automobile increases.

VEHICLE TOP.—G. BAHER, Paris, France. One of the principal objects of the invention is to provide automatic fastening means in conjunction with a construction of this character, which prevents the vibration of the glass panels, thus relieving them of shocks and preventing their breakage, as well as enhancing the comfortable and agreeable features of pleasure cars or automobiles.

CHANGE SPEED GEARING.—G. Q. SEAMAN, JR., 15 Nolans Lane, Brooklyn, N. Y. The object of this invention is to provide a change speed gearing more especially designed for use on automobiles and other power-driven vehicles, and arranged to permit the operator to conveniently change the speed from a low to a higher speed or vice versa or to reverse. A further object is to render the gearing exceedingly compact.

FUEL TANK.—V. W. PAGE, 532 5th Ave., Suite 341, New York, N. Y. One of the primary objects of the invention is to construct a fuel tank compartment in such a manner that an overflowing of the fuel contained therein owing to a leak in the tank or to carelessness in the filling thereof, will be conveyed to a point exterior of the vehicle body. A further object is to so construct the tank that it is readily accessible, and has no communication with the passenger compartment of the vehicle body.

COLD WEATHER STARTER FOR MOTOR DRIVEN VEHICLES.—E. C. and E. A. GEHRKE, C Box 53, Chelan, Wash. This invention relates to means for priming the motor of a vehicle in cold weather, and has for its general object to provide a device which will overcome the disadvantages of a primer dependent on engine suction for the feed of the primary fuel and at the same time will avoid the use of a pump or like pressure device to cause a feed of the primary fuel.

PNEUMATIC TIRE PROTECTOR.—C. TAYLOR, 15 Cross St., Newport, R. I. This invention relates to a shield for inner tubes of pneumatic tires. The object is to provide light sheet metal sleeve sections which may be interposed between the outer casing and the inner tube of a pneumatic tire which will be adapted to protect the inner tube from puncture, and will yield with the pressure exerted upon the outer casing but not perceptibly decrease the resiliency. (See Fig. 17.)

JOURNAL BOX.—W. C. SKEELS, c/o G. A. Fitzsimons, 502 Baltimore Bldg., Oklahoma, Okla. An object of this invention is to provide a journal box especially adapted for use in connection with vehicle wheels, and one wherein such journal box may be readily applied within the hub and effectively held therein, and wherein end play or thrust is substantially eliminated and the use of cone bearings unnecessary.

STEERING MECHANISM.—G. T. NELSON, Box 380, Beaumont, Texas. The principal object of the invention is to provide means whereby the engine of a motor vehicle may be used as a source of power for propelling a pontoon or the like, by using the rear wheel power for rotating the propeller of the pontoon, and the front wheel steering apparatus to steer the pontoon, permitting the operator to remain in his seat and exercise full control.

VARIABLE SPEED MECHANISM.—S. W. GRIFFIN, New Athens, Ill. A purpose of the invention is to provide a variable speed mechanism in which the speed is automatically varied in accordance with the speed of the vehicles and the load of the engine, at the same time maintaining the rotational speed of the engine practically constant. It is also a purpose to provide mechanism so associated with the tooth gears as not to actually constitute a part of the mechanism between the driving and driven shafts.

WHEEL FOR AUTOMOBILES.—J. P. JACOBS, c/o Jacobs Auto Co., Shelbyville, Tenn. The object is to provide a demountable rim which is of simple and durable construction, which may be easily assembled and disassembled, which is automatically locked in position and which when assembled is positively secured against lateral as well as radial thrust.

TRANSMISSION GEAR.—C. BEARENS, 106 Bank St., New York, N. Y. The invention has for its object to provide automatic shift features whereby the transmission will be thrown into intermediate gear for the starting of the car and if the resistance be too great, there will be an automatic shift to low gear, the assemblage including also a high gear direct drive arrangement which is automatically brought into action as the momentum is acquired.

SANDING MACHINE.—L. MILLER, c/o Williamsburg Glass Works, 429 Berry St., Brooklyn, N. Y. The general object of the invention is the provision of a device, that may be used in conjunction with automobiles, and which will operate to spill sand in front of or behind the wheels so as to create a good gripping surface for the tires, on wet streets or roads.

PINION SHAFT HOUSING.—V. W. PAGE, 522 5th Ave., New York, N. Y. The invention relates to pinion shaft housings for motor vehicle drivers. Its primary object is to provide a construction which will permit of the use of magnalite, lynnite, and other aluminum alloys in this connection with the result that the various advantages gained from using light material for this purpose will be attained without loss of strength and durability necessary to these parts.

DETACHABLE ARMREST FOR AUTOMOBILES.—T. H. DECKER, 2130 Farragut Ave., Chicago, Ill. An object of the invention is to provide a simple inexpensive and practical armrest that is adapted to be detachably applied or removed from the automobile frame or body without the use of tools. The device is strong and durable and occupies but little space when not in use, so that it may be readily carried in the tool box.

CURTAIN.—R. SNOECK, 206 W. 103rd St., New York, N. Y. The invention relates to curtains for touring cars and roadsters. The object is to provide a curtain adapted to be arranged between the top and body of a vehicle, and which shall present a neatness of appearance corresponding to a sedan type of vehicle, and although the operator will be protected from the elements he will be capable of extending his arm beyond the body of the vehicle for signalling, or his head for observation when necessary.

TRACTOR HITCH.—M. M. KNOWLES and J. N. BATES, c/o Madison M. Knowles, Fort Branch, Ind. The general object of the invention is to provide a tractor hitch of simple construction which may be readily applied to the stub tongue of a binder and which will afford a desirable flexibility with strength. With this device the desired line of draft is secured as well as lateral flexibility

ADJUSTABLE SUN AND LIGHT DIFFUSER.—T. J. TREICHEL, 724 Golden Gate Ave., San Francisco, Calif. The invention particularly relates to light dimming means for automobiles. The principal object is to provide a sun and light diffuser that will shield the eyes of the driver from the sun or approaching automobile, the device may be conveniently attached to the windshield, and swung into proper position in an instant, and will automatically swing back upon release.

BED FOR USE ON AUTOMOBILES.—E. V. LOUSTALOT, address Emmet Alpha, Franklin, La. The invention relates to a bed adapted for use on an automobile, having suspension means adapted to connect with the back of the automobile body. More specifically, the invention has for a purpose to provide a bed having a mattress frame formed of head-and-foot sections pivotally connected for one to fold onto the other and provided with elements thereon at the under side adapted for coengagement to truss the frame at the joint. (See Fig. 18.)

AUTOMOBILE LOCK.—A. F. LEWIS, address Balaam & Balaam, 119 State St., Santa Barbara, Calif. The object is to provide a simple rigid means that may be easily applied for fastening the brake lever when in its active position, or the clutch lever when it is in inactive position to the gear change lever in any one of its positions, or to any other member in front of the seat, and means for locking the fastening means in position.

COMBINED TIRE GAGE AND FILLING VALVE.—A. A. FREEMAN, 1501 79th Ave., Oakland, Calif. The invention, while relating to a combination valve and gage structure, has reference more particularly to a combination tire gage and filling or inflating valve. An object is to produce a device which will be simple, cheap to manufacture and without embodying an undue number of unnecessary special contrivances.

STAMPING DEVICE.—J. A. CAMPBELL, Carbondale, Ill. The invention relates more particularly to tool for marking an automobile in various places, such as on the fender, hood, apron, cowl, body and other parts by stamping identifying letters or symbols such as initials of the owner, the purpose being to make difficult the obliteration of the marks by thieves. The general object is to provide a tool which may be readily applied to the part to be marked.

FOLDING SEAT.—A. CARLSON, 430 Belmont Ave., Springfield, Mass. The object of the invention is to provide a folding seat especially designed as an auxiliary seat for automobiles and arranged for convenient extension to support a person facing forward, backward or sidewise without interfering with the occupants of the rear seat. The device may be folded and concealed in the storage chamber in the front seat, thus permitting easy ingress and egress.

ARRANGEMENT FOR THE INSTANTANEOUS REPAIRS OF SUSPENSION SPRINGS OF VEHICLES.—F. R. G. RAYNAUD, 14 Rue Piccini, Paris, France. The invention has for its object an arrangement comprising two pairs of bridges or coupling plates, permitting of effecting an immediate repair to springs of vehicles, broken at any point of their length, and which can be applied to the springs whatever the width of the leaves of the spring or the thickness of the latter.

SHOCK ABSORBER.—R. M. GRUSS, 833 Market St., San Francisco, Calif. The primary object of the invention is to provide a shock absorber for motor vehicles, and refers more particularly to that type of shock absorber which is of cylindrical form employing air as a cushioning medium. The device is inexpensive yet efficient for absorbing the vibration incident to traveling over uneven road surfaces.

WATER TANK.—E. WOOD, Tuttle, Idaho. An important object of the invention is to provide a water tank mounted upon the cowl of a motor vehicle, and having means whereby the water in the cooling system of the engine may be replenished. A further object is to provide a water supply means which is simple to apply, neat in appearance and inexpensive to manufacture.

SHOCK ABSORBER.—E. S. LEHR, Salt Creek, Wyoming. The object of the invention is to provide a shock absorber for spring suspensions which is especially effective to dampen or cushion the rebound to thereby relieve the vehicle of sudden shock and jars to preclude breakage of the parts of the running gear and associate structure and to give to the vehicle qualities of easy riding and of comfort. (See Fig. 19.)

Designs

DESIGN FOR A HANDKERCHIEF, NAPKIN, OR SIMILAR ARTICLE OF MANUFACTURE.—J. HARDEN, c/o Acheson Harden Co., 66 Leonard St., New York, N. Y. The inventor has been granted patents of four designs for the above purpose.

DESIGN FOR A DISPLAY SHAPE OF AN ARTICLE OF CLOTHING.—A. N. OPPENHEIM, Oppenheim, Oberndorf Co., Baltimore, Md.

DESIGN FOR A RING OR SIMILAR ARTICLE OF MANUFACTURE.—M. BAUMAN, c/o Max Bauman & Co., 170 Broadway, New York, N. Y.

DESIGN FOR A LAMP.—G. J. ROMULUS, 1 Reed St., Lynn, Mass.

DESIGN FOR A FINGER RING, FOB, SCARFPIN, OR SIMILAR ARTICLE OF MANUFACTURE.—J. and T. YAPPELLI, address H. Hickman, 50 Pine St., New York, N. Y.

Science Notes

Breeding Zebras.—A farm near Millbrook, N. Y., is to be devoted, in part at least, to breeding zebras. The animals are handsome and, while not specially adapted for riding or heavy draft like the horse, are docile in harness and are very showy.

Telegraph to Lhassa.—The "Forbidden City" is now linked to the outer world by the telegraph, which is all the more remarkable when it is remembered that visitors up to a few years ago rarely escaped with their lives.

Find of Old Japanese Temple Records.—While repairing a temple near Osaka, which was built in 852, workmen found records made between 1087 and 1120, giving the names of sculptors, etc. An expert of the Fine Art Institute is investigating the records at the instance of the educational department.

Traveling Fumigator Fights Boll Weevil.—A freight car fumigator house having a capacity of 14 railway cars at a time has been completed and put into operation by the United States Department of Agriculture. It is part of a chain of fumigation houses maintained to prevent the entry of the pink bollworm of cotton into this country.

Need of Rabbits for Pasteur Treatment.—The *Deutsche Medizinische Wochenschrift* relates that the Pasteur Institute of the Breslau University appeals to everyone who desires to be treated for the bite of a supposedly rabid animal to bring one or two rabbits. The price paid for the rabbits will be refunded. Unless this is done, there may be danger of not being able to apply the treatment properly.

Exotic Pets in London.—The dog is threatened with eclipse in London as a street companion of fashionable women of the ultra-fashionable set. Monkeys, marmosets, mongooses, foxes, and chimpanzees, all come in for a share of attention. At a lawn party a guest carried a sunshade with a curiously twisted handle, which proved to be a beautifully marked snake. It is to be hoped that such novelties will never be imported here, as a snake out of captivity frightens and disgusts many people.

Ascalon of the Crusaders to Be Uncovered.—Ascalon, one of the chief cities of the Philistines, and an important objective in the plans of the Crusaders, is to be excavated by the British Archæological School of Jerusalem. Results of great importance will be looked for. David's lament, "Tell it not in Gath, publish it not in the streets of Askelon," gives it its place in Biblical history. The Christians won a great victory on August 15, 1099, over the Saracens on a neighboring plain. It was almost totally destroyed by the Sultan in 1270, and its artificial harbor was filled up with stones.

Sorrow at the Zoo.—Yes, the platypus is dead, and passed away 15,000 miles from home at that. The emotion which the director of a zoological park feels when the Grim Reaper takes away a star attraction can only be pictured. The bashful duck-billed stranger from Australia survived for 49 days, a record for the singular little anomaly of the animal kingdom. If the New York Zoological Society ever obtains another specimen it is hoped that everyone will visit the platypus early, as they do not remain long in captivity.

"Toilers of the Sea."—Victor Hugo's story of a man being attacked by a devilfish (so called) has thrilled the spines of several generations. We now have a confirmation of the gruesome incident, for a fishing boat was attacked by a giant octopus, near the Island of Jersey, or near the exact location in the story. The fight was a heroic one, for one man was dragged overboard, and only escaped by chance. The boat was almost capsized by the terrible inhabitant of the sea. Finally, with the aid of knives and boathooks, the monster released its hold and sank its mutilated remains.

Moving Pictures in the Vatican Not New.—Recent press dispatches state that moving pictures have invaded the sacred precincts of the Vatican, but Pope Pius and Pope Benedict were not the first Popes to be screened for the edification of the faithful. As a matter of fact, in 1898, Pope Leo XIII posed for a long series of moving pictures which were considered very wonderful at the time, and were shown early the next year at Carnegie Hall, New York City, as the writer very well remembers, and, incidentally, the SCIENTIFIC AMERICAN was used to bring up the subject to the Pontiff in the early days of moving pictures.

Miscellaneous Notes

Anglers Take Notice. — At Highgate, England, anglers have found that by hanging umbrellas on their fishing rods, the shadow attracts fish to their bait.

Railway Post Office Car Mileage. — The total number of miles covered by full-length cars and compartment cars reached the enormous figures of 551,875,000. It is estimated that this is equal to one sack of mail being transported 228,960,000,000 miles.

Glass Top "Rubberneck" Car Speeds Sightseeing.—A New York observation, or "rubberneck," bus company has installed glass tops on its automobiles. Formerly they either had to stop at all of the important high buildings to give those whose seats were not on the outer edge of the bus a chance to see, or else have them miss seeing something. Now the glass top has the advantage of being as good on rainy as on clear days. They have found these new buses just as popular on stormy as on clear days.

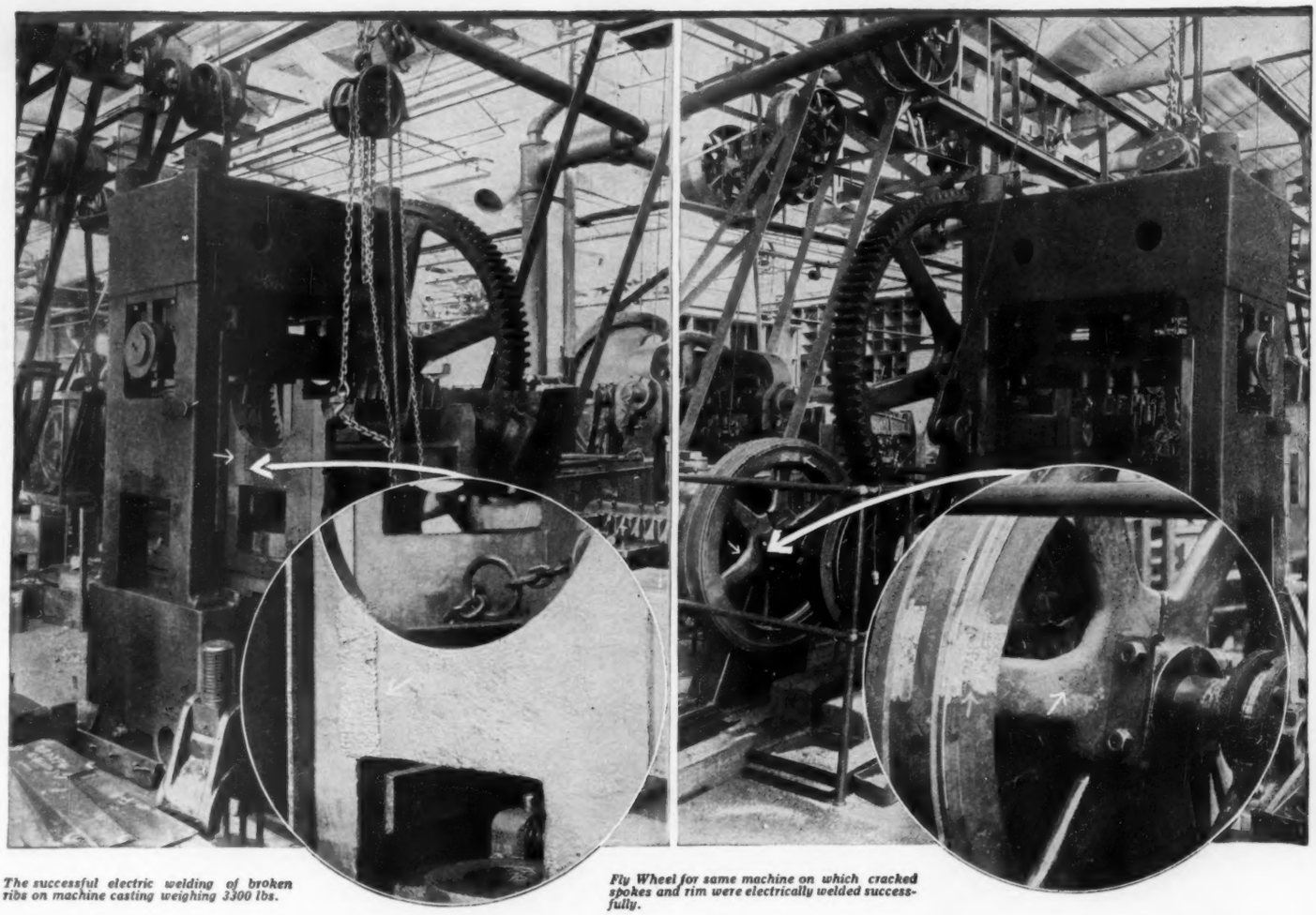
Majagua for Baseball Bats.— About two years ago experiments proved that Cuban majagua was ideally adapted for the manufacture of baseball bats. This hardwood is of tough fiber and it can be used for any purpose requiring material that will not break easily. Within the past year a growing interest has developed in the United States in the importation of majagua for the manufacture of baseball bats. For this purpose it is cut into pieces 38 inches long and 3 inches square. One firm exported to the United States during the past year 1000 of these pieces.

Do You Receive Your Quota of Mail?— Did you receive 112 letters last year. If you didn't, you failed to get your *pro-rata* share. According to estimates just completed at the Post Office Department, about 11,325,000,000 letters are now going through the U. S. mails every year. Figured on the basis of the last census of the population of the country, each citizen should have received an average of 112 letters. Upon these figures post office officials claim that the United States leads the world in the interchange of letters between its people. It is estimated that the *per capita* number of letters exchanged in Great Britain is 84 annually. Of other important countries Germany has a *per capita* exchange of 25, while each Italian received nearly as many, the rate being 24 per person. These estimates are all based on first-class matter alone.

Cotton Raising in Africa. — Steady progress is being made in the establishment of the Niger River Valley cotton experiment station, located in West Africa. The work is being done under the auspices of the French colonial authorities of Occidental Africa, who have selected Dr. Herbert H. Forbes, former dean of the College of Agriculture of Arizona, to report on the project. The French Consortium Committee has alloted the money for the station, and cotton-seed and a selection of cotton plants have been sent to the station from the United States and Egypt. The first cultures will give returns during the winter of 1922-23 and will be used to secure a sufficient stock of pure cottonseed for the 1923-24 season. The irrigation work contemplates ultimately an irrigation dam similar to the Assouan dam on the Nile. Temporary pumping stations to care for the 1923-24 crop have been installed.

The Forging of Finger-Prints.—It is disconcerting to learn from an article by Mr. J. C. Goodwin in the third number of the new publication, *Dactylography*, that the practice of forging finger-prints is increasing and will soon become a problem for New Scotland Yard. The criminal must first obtain specimens of the prints of the dupe on whom he intends that suspicion should fall. This he does by arranging that the dupe leave his prints on a glass, or on a polished piece of furniture, after which the prints are photographed. One method of forging involves the use of a rubber stamp, where a facsimile of the original is reproduced on the rubber by means of transfer paper, and the surrounding rubber deftly pared away with a sharp knife. The second method is to take a negative cast of the finger to be forged by pressing it into a mold of soft wax, plaster of Paris, clay, or even bread. A third process involves photographing a photograph of the prints to be forged on a reversed plate, which is clamped to a duplicate plate made of gelatine mixed with bichromate of potassium. The two are exposed to the light, with the photographic negative nearer to the light, and the sensitized surface touching the gelatine.

Electric welding saved this machine



The successful electric welding of broken ribs on machine casting weighing 3300 lbs.

Fly Wheel for same machine on which cracked spokes and rim were electrically welded successfully.

The following extract is from a letter to us by Enoch Ohnstrand, Chief Engineer, LIBRARY BUREAU, Ilion, N. Y.

"We figure that this repair on this machine showed a sufficient saving to pay for the installation of our electric equipment, as the machine which was broken down was a special machine made years ago for this Company, and even if it had been an up-to-date machine, we could not have purchased this part for anywhere near the price of the electric welder which we purchased from you and which we used for doing this work. I am pleased to advise you that we got splendid results from the job and in a very short time. The repairs, so far as welding was concerned, were made in about three hours actual time."

The line of G-E Electric Arc Welders includes types of stationary and portable sets for hand welding—and automatic and semi-automatic machines. G-E Specialists are at your service to select the equipment essential in electric welding processes for repairs, production or salvage in your plant.

General Electric Company

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The Naturalist's Corner

Mongoose Skins May Be Valuable.—The Mongoose, introduced into Trinidad to destroy rats and snakes, has itself become a serious menace. Our Consul suggests that the many thousands of skins might be profitably utilized.

Walnut Trees Valuable.—Pennsylvania has planted 150 bushels of seed to renew her supply of this beautiful and useful tree. It is comparatively fast-growing, yields a remunerative nut crop, and its lumber is in demand for furniture and for house trim.

Mistletoe Condemned to Death.—The seeds of mistletoe are great travelers, and wherever they go the growing trees are strangled to death. The Department of Agriculture has decreed the wholesale destruction of mistletoe in the forests of the Northwest.

The Killing of Lobo, the Wolf.—For three long years Lobo fattened on the cattle of the Arizona plains; from one ranch alone, in one year, he seized 50 fine white-faced yearlings. A government hunter, in an automobile, has at last brought Lobo down with a single shot from a rifle with the rear sight missing. The wolf weighed 78 pounds after the skin from shoulders to head was removed, and was the largest ever seen on the range; his disposal means a saving of several thousand dollars in stock annually.

Our Greatest Fishing Preserve.—This reputation is assured to the Yellowstone Park, for the Park Service, aided by the Bureau of Fisheries, last season restocked its lakes and streams on a larger scale than ever before. Eggs of native trout collected in the Park numbered 5,996,000; 2,871,000 of these, developed to the stage of eyed eggs and fry, were returned to the waters there; to these were added from outside hatcheries sufficient to bring the total planting to 4,051,000, or double the number planted in 1920.

Lord Grey's Bird Sanctuary.—On his Scottish estate of Falloden Lord Grey has for 30 years maintained a sanctuary for wild fowl; in all those years not a gun has been discharged on the estate. The 10 British and 13 foreign species feed from the hand of their master, who has many stories of their habits and behavior. One is that of a faithful drake; after ten years with one mate, the mate died. The drake searched disconsolately for her for several days, and was last seen winging far out over the North Sea.

Limiting Hunting Licenses.—The hunter-population of our woods and fields this past autumn probably numbered 5,000,000. This points the need of uniform and more adequate laws to protect our vanishing game. The Department of Agriculture notes the practice of granting hunting licenses to all applicants with little regard to local game supply. The Department advocates a limited license plan for big game based on annual estimates of supply in each district. This should result in the much-needed conservation of wild life.

Status of the Shark Fishery.—The attempt to put the shark fishery on a permanent basis is progressing satisfactorily in spite of adverse conditions in the fishing industry. It has been proved that the hides provide leather of good quality for bags, collar boxes and similar goods, and that a nourishing meal for feeding purposes is obtainable from the flesh; the leather is now being tested in shoes. Oil and scrap are at present bringing low prices, but the demand for fins exceeds the supply. Investigation is necessary as to the taking of sharks in commercial quantities and the areas and seasons of greatest abundance; the Government appropriation is exhausted, but private enterprise should now be able to handle the situation.

Woman, Accessory Before the Fact.—According to Dr. William T. Hornaday it takes 80 skins to make the average mink wrap, 200 for a squirrel coat, and 280 for a black mole coat; 90 skins may go to the making of a striped skunk jacket, and 300 to a Siberian ermine wrap. Before many years, if the present rate of slaughter continues, many of our most interesting animals will be practically extinct: even now the trapper is forced farther afield, and skins once unmarketable are being used to supply the deficiency; nearer home, the fur of the fireside sphinx appears as trimming for milady's apparel, disguised under the name of "genet." Very little of this murder is excusable on the grounds of necessity, and mere self-interest should lead the sex mainly responsible for it to ponder this truth: No more fur-bearing animals, no furs.

Co-operation—Builder of Cities

Here is a thought for the thoughtful—for men who would like to see their community develop in size and influence and resources, and as a place in which to live and to be in business:

The transportation requirements of each community—and the problems involved in meeting these requirements—deserve consideration by the people of a community, as well as by the company that must provide them. For the problem of the carrier and the carried is a *common problem—and only co-operative thinking and working will solve it.*

Few realize how much community development depends on adequate transportation, nor do they give due credit to the Electric Street Railway for its contribution to local well-being and prosperity. Fewer still recognize the importance of co-operation in fostering and strengthening existing transportation facilities.

Co-operating in the solution of the technical problems involved is a corps of Westinghouse Engineers, whose goal is the development of Electric Street Railway Equipment that will do a real job for companies, and for communities, that are to meet their transportation needs with the greatest possible measure of reliability—and economy.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY · *Offices in all Principal Cities* · *Representatives Everywhere*

Westinghouse

Civil Engineering Notes

Penetration-Macadam practice in Great Britain deserves notice in two particulars of construction which are not often given such careful attention by American road builders. They are testing an old road surface to determine its sufficiency as a foundation and protecting the stone course from rain and removing rain water by means of driers, so that the penetration of the binder is assured.

Rio Grande Rectification.—As a result of destructive floods in recent years, it is seriously proposed to undertake extensive alterations in the river channel in the El Paso district. Progressive rise of the river bottom and the water table in and around the city have now reached the point where very moderate flood stages in the stream entail heavy property losses. A scheme is outlined for shortening the channel, by straightening, to such an extent that a materially sharper run-off may be obtained. The necessity for securing the Mexican Government's approval and perhaps even cooperation is apparently the chief obstacle, though the engineering difficulties are also such as to call for thought.

Fire Hazard on Wooden Piers. — Destructive fires in shipping piers, *Engineering News Record* points out, occur with distressing frequency. Considering the number of such piers in existence, the fire loss per square foot area is probably greater here than in any other type of structure. That much of this loss is the result of negligence in design and construction is pointed out. "It is to be hoped that the next engineer who comes to design a wooden pier will appreciate first, the ease of conflagration spread in the wide open pier; second, the inflammable contents of the ordinary pier warehouse, and, third, the tendency of any shipping pier to become unapproachable from shore by fire-fighting apparatus. These may lead to a better layout, a more fire-resisting construction and a more efficient supervision than the New Orleans pier exemplified.

Federal Recommendations for Road Widths.—Minimum width of 18 feet for hard-surface roads is recommended by the United States Bureau of Public Roads. The maximum width of truck generally permitted is 8 feet, and 5½ feet is the ordinary clearance width of automobiles. At an average speed of 30 miles an hour it is unreasonable to expect the driver of an automobile to drive with the wheels closer than 1½ feet to the edge of the pavement, says the Bureau. For trucks at an average speed of 15 miles an hour, this distance should not be less than 1¾ feet on account of the great width of the rear wheel. Three feet seems to be a minimum safe clearance between bodies. Inasmuch as a certain amount of truck traffic is to be expected on all main country roads, the minimum width of surface should be 18 feet to provide these clearances when an automobile meets a truck. Where the frequency with which trucks pass each other becomes a big factor, as in the neighborhood of large cities, the minimum width of pavement should be 20 feet to provide a clearance of 3½ feet and a safe distance of wheels from edge of pavement.

Bad Boiler-Water has been a serious problem on the lines of the St. Paul Railroad in northwestern Iowa and southeastern South Dakota, where the few streams that are present run through soils extremely rich in soluble calcium and magnesium salts. The difficulty is accentuated, rather than relieved, by rainfall; the more rain the higher the rivers, and the more salts abstracted from land ordinarily dry and hence rich in these substances. It has been found that chemical treatment of such water soon pays for the plant; and in the region described, the company has now no less than fourteen such establishments, which treat all the water used on the locomotives of the district.

Concrete Laying in Cold Weather was carried on in a rather unusual manner on a five-span concrete arch bridge over the Cedar River at Waterloo, Iowa. For covering the green concrete ordinary manure was used instead of plain straw. This covering was laid ahead of the mix, cleats and scrap lumber being nailed in place in sufficient quantity to hold it in place. The mix was heated to 60 degrees in the mixer, and laid and cured without further application of heat. Though the temperature of the outside air was on occasion as low as two degrees, the concrete at no time within 96 hours after laying went anywhere near the danger point; and frequently it actually rose in temperature after laying, due to the evolution of heat from the manure.

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Civil Engineering Notes

Ammonia Gas Livens Up the Aquarium.—Firemen in the New York Aquariam certainly look as much out of place as a fish out of water, but when the ammonia tank leaks who can stop it but the rescue squad with their gas masks? The fish did not mind at all, but there was trouble with the sea lions, the seal, the alligators, and the turtles. None of them had sense enough to submerge, and declined all assistance from the keepers. They all knew something was wrong, but insisted in remaining on deck, as it were. Finally the leak was stopped and the inhabitants resumed their normal existence without any casualties being reported. The refrigeration plant is used to keep the fish fresh for food for the inmates of the circular structure.

London Not Ready for Skyscrapers Yet.—Just how far London is from the skyscraper stage will be seen when it is stated that the highest building in London is Whitehall Court, the home of the National Liberal Club, which is 110 feet high. But the London County Council has made some concessions to the demand of West End business firms that they be allowed to erect loftier stores, but the concessions fall far short of permitting the construction in London of buildings modeled after American skyscrapers. Confessedly the concession as to height asked for was 120 feet maximum on favorable sites. Builders have been authorized to put up buildings 80 feet high, and on favorable sites the municipality may even permit buildings 100 or even 140 feet high.

Man's Reaction to High Altitudes.—Observations of great significance are disclosed by scientists returning from the Andes. Up to 17,000 feet the condition of whites and natives was studied. At sea level the arterial blood is saturated with oxygen; in the mountains, this content is lower and in equilibrium with the oxygen content of the air; this would seem to dispose of the theory that in oxygen deprivation the lungs secrete oxygen to make up the deficit. Anthropometric measurements and X-ray pictures contributed greatly to success; the blood was tested in numerous ways and the basal metabolism came under observation. The findings have a practical bearing on aviation, and on the fitness of industrial representatives for high altitude work. Light may also be shed upon the proper treatment of diseases of the lungs and the circulatory system.

Condition of French Railways.—Apart from the astonishing amount of work which has been done by the French in rebuilding those of their railroads which were wrecked by the war, they have also made a notable improvement in their rolling stock. A statement recently made by the Minister of Public works shows that in 1914 there were 2717 locomotives, 7764 passenger cars, and 15,000 freight cars that needed repairs. In December, 1919, as a result of the war, these totals stood at 3418 locomotives, 13,800 passenger cars, and 59,300 freight cars. At the present date the totals have come down to 2717 locomotimes, 7764 passenger cars, and 49,134 freight cars. Much of the credit for this work should be given to private industry; for, whereas in pre-war times all repairs were done in the shops, the present policy is to allot some of the repair work to private firms.

The Immured Imperial Standards.—The copies of the Imperial Standards of the British Yard and the British Pound were examined recently in the House of Commons. Report was made that comparisons with the Imperial Standards showed that these copies had slight variations. The yard measure was one-tenth thousandth of an inch shorter than the Imperial Standard, while the pound weight was 0.00286 grain heavier than the Standard. The measure consists of a bar of bronze with the exact yard marked upon it; while the pound weight "copy" is made of platinum. It was stated that the old Imperial Standards having been lost in the fire which destroyed the Houses of Parliament in 1834, new Standards were constructed in 1844 (for the pound) and 1845 (for the yard); at the same time four sets of copies were ordered by Parliament to be made, of which two were to be deposited at the Royal Mint and the Royal Observatory, one was to be entrusted to the care of the Royal Society, and the fourth was to be immured in the Houses of Parliament. After inspection the copies were replaced in their original boxes, which were hermetically sealed in a lead sheathing and placed in an outer box, which was then reinterned in the staircase wall.

Electrical Notes

A High-Voltage Indicator is described in a recent issue of *Elektrotechnische Zeitschrift* as follows: In the middle of a long tube of insulating material is suspended a light metallic needle, which, by means of a delicate helical spring, points about 15 degrees off the main axis of the tube. At the upper end of the tube a metallic cap is attached and at the bottom another one. The former is connected to the line, the latter being grounded. If the line is alive, a potential drop will exist along the tube from full voltage to zero. As the length of the needle covers a considerable portion of this voltage gradient, its two ends will be electrostatically attracted toward the axis of the tube, with the result that if the line is alive the needle will align itself with the tube. To protect the delicate needle, the middle part of the tube with the needle is surrounded by a glass cylinder. For a voltage of, for example, 60,000, the tube is made almost a yard long. The instrument is made for 6000 volts to 80,000 volts.

Electricity and Blast Furnace Gases.—In a recent issue of *General Electric Review* N. H. Gellert discusses the various difficulties encountered in the problem of cleaning blast-furnace gas, and the method of making the gas measurements necessary to determine the required capacity of the cleaning equipment. A description is given of the various features of an electrical precipitation plant for the cleaning of this combustible gas. In this method the gas is passed through a vertical pipe, in the exact center of which is suspended an electrode chain or wire. This electrode is suspended from insulators and is charged with high-tension direct current. The pipe itself is grounded. The dirty gas in passing through becomes ionized, and the gas molecules carry the charge to the dust and fume particles, which are repelled by the negative chain electrode and are deposited on the sides of the pipe. At Sheridan, Pa., the precipitator based on this principle has been operating continuously and collecting approximately 5000 barrels of dust per day.

A Combination Heater, Cooler, Radiator and Deodorizer, electrically operated, has recently made its appearance in England. The apparatus is in a portable form and can be used for central heating or for the circulation of cold air which is emitted at 15 degrees below the temperature of the ingoing air without the use of ice, and the air in either case can be disinfected by encalyptus or other fluid disinfectant, the fluid having been previously absorbed by porous and perforated bars through which the air passes. The air is drawn through the radiator by a motor-driven fan which can be run at speeds varying from 900 to 450 revolutions per minute. When used for heating, the number of elements in operation can be increased or decreased at will. It is claimed that every heat unit is extracted, and this seems to be borne out by the fact that the metal case becomes cold instantly, when the current is switched off. When used for the supply of extremely cold air the blast from the fan passes through an auxiliary attachment in which blocks of ice are contained in a perforated zinc tank.

The Highest Voltage Testing Transformer Equipment that has ever been sold is now being manufactured. It will be installed in the new high-voltage testing laboratory now being constructed on the grounds of the California Institute of Technology at Pasadena, Calif. A voltage of 1,000,000 volts to ground will be produced by this equipment, its capacity being 1000 kv-a., or 1340 horsepower, at this extremely high voltage. The apparatus consists of four special 250 kv-a., 250,000-volt testing transformers connected together so that their individual voltages will be added. This arrangement requires that the transformer tanks be insulated from the ground, the insulation increasing as the transformer voltages increase. This will necessitate mounting of the transformers on wooden platforms at various heights from the ground, the last transformer being on a platform approximately 12 to 15 feet high. It is interesting to note that a potential of 1,000,000 volts between terminals one meter in diameter will cause a spark to flash across an air gap of approximately 45 inches and, when between needle points, it will jump an air gap of from 12 to 15 feet. The 1,000,000-volt testing equipment will greatly facilitate scientific research and, it is understood, investigations will be carried on concerning the properties of the matter.

Mechanical Engineering Notes

The Photostat has a place in production which is not always realized. It has more than once been the means of effecting a decisive saving in time through the elimination of extensive tracing.

Flexible Couplings are available in a wide variety of forms, but few of them are as simple as one which we recently noted. This consists merely of two sprockets of identical size and shape, placed face to face; with a roller chain around the edge to hold them together. This looks like one of the things that impel us to inquire "Why didn't we ever think of that before?"

The Reheating of Compressed Air forms the subject of a recent report from the University of Illinois. This report is available for distribution by the University (Urbana, Ill.) at the price of 50 cents. Aside from the ground specifically covered by the title, some very suggestive data in reference to the use of air-steam mixtures were turned up during the investigation, and included in the report.

Valve Manipulation is reduced to its lowest terms in a model wherein the power applied to the handle is transmitted to the plug by a cam. This makes it possible for a quarter-turn of the handle to carry the valve from the full open position to the full closed one. In addition, it is claimed that the plug, while held firmly in its seat, is free enough to be turned easily, so that valves have been opened by hand, without effort, which had been hammered shut.

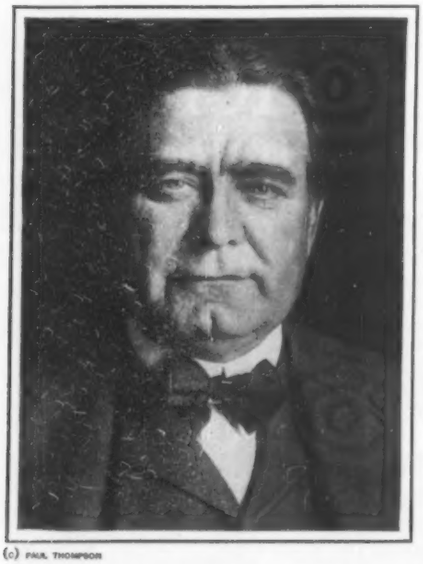
The Specialization of Modern Machine Work is perhaps even greater than one would realize. The good old days when we did everything on a lathe or a planer, with perhaps a grinder thrown in for good measure in an unusually well equipped shop, are gone. We are moved to this observation by noting no less than five advertisements of key-seat cutters in a single issue of a current technical journal. Would your grandfather have been able to identify one of these machines if it had been presented to him?

New Canadian Thrasher.—In the agricultural machinery display of the Manitoba Provincial Fair, held recently at Brandon, a new centrifugal thrasher was shown, which, it is claimed, will revolutionize the thrashing industry. The new machine is operated with centrifugal force, while others are governed by gravitation. It is much smaller than other machines and has a total of only 16 bearings, as compared with 128 in others. It is said that the inventor (a Canadian) has refused to sell his rights to a United States firm, despite a very tempting offer.

The Maxim Silencer, to most of us, suggests a detective story in which the victim of the murder plot is shot down in broad daylight in the midst of a big crowd. It has other and more legitimate uses, however, than the masking of the source of a revolver shot. It is claimed to be the most efficient noise-reducing device yet produced for gas and oil engine exhausts and suctions, air-compressor suctions, air hoists, air and steam discharges or safety valves, steam traps, blow-offs, etc., and it seems really surprising that one does not see it in more general use for such purposes.

Blueprinting from Typewritten Sheets is reduced to its simplest terms by the suggestion of C. G. Salmon in a recent issue of *American Machinist.* No special ink or ribbon is required for the typing, which is done on Japanese tissue paper. After the copy is thus made, the paper is rendered transparent by application of a special oil, whose effects are quite permanent. The oil may be obtained from almost any dealer in drafting supplies. Where it is unavailable, gasoline or benzine may be used subject to the drawback that they evaporate rather quickly and leave the paper in its original condition.

Longer-Lived Plug Gages will result from a new model recently put out by one of the leading manufacturers of precision instruments. The gage ends are reversible, by means of an ingenious screw arrangement; and with equal ingenuity they lock upon their three-point suspension in such a way as to eliminate all rocking, shaking, or other indication that they are not all in one piece. The entire barrel of the plug-end being guaranteed within the specified tolerances, when the entering rim becomes worn beyond the point of further utility the end is removed from the handle and put back upside down, giving a new gage again.



(c) PAUL THOMPSON

William E. Borah of Idaho is one of the most distinguished members of the United States Senate

Radio Notes

Transatlantic Tests for 1922.—The third series of Transatlantic Amateur Tests will be conducted by the American Radio Relay League in cooperation with the radio amateurs of England, France and Holland. The tests will be conducted from December 12th to December 31st, inclusive. During the first ten days of the tests, American and Canadian amateurs will transmit signals for reception by the radio amateurs of the European countries. Those of the American and Canadian transmitters making the best records as determined by reception reports from the European amateurs, will be used to transmit the results of reception by American and Canadian radio amateurs when the English and French radio amateurs are transmitting. It will be remembered that last December thirty radio amateur transmitters succeeded in bridging the Atlantic.

The Light Socket as an Antenna.—Various devices have made their appearance of late, having for their object the elimination of the usual outdoor antenna. The use of wire loops is well known, but these substitutes for the usual outdoor antenna require radio-frequency amplification or the new Armstrong super-regenerative arrangement to permit of covering a fair distance. The latest method for doing away with the usual outdoor antenna is to use one of the several attachment plugs now available, permitting the receiving set to be attached to any electric light socket so that the electric wires form the antenna. The special plugs generally contain two or more mica condensers, and provision is made so that various combinations of the two wires and the condensers can be obtained until the most satisfactory results are attained. Remarkably good work can be done with such an attachment and the usual electric light circuit. This method is especially desirable in city apartments, where outdoor antenna will not be permitted by the landlord.

The Return of Radio.—With cold weather at hand and indoors far more inviting than outdoors, we are face to face with a decided revival of radio interest. Following the radio craze of last winter and spring, we ran into a serious slump. This condition was due to several causes: first of all, summer weather is not conducive to good radio results, because of static interference; secondly, summer weather calls everyone outdoors, and radio is primarily an indoor sport; thirdly, too many manufacturers and others jumped into the radio manufacturing business, and as a consequence much inferior apparatus made its appearance along with the good apparatus. That there has been an overproduction of radio material is certain, although it is equally true that of the good apparatus there never has been and there still is not an overproduction. Now, with the return of cold weather and with the radio industry undergoing a clarifying process for the purpose of eliminating unsatisfactory apparatus, radio is on the upward trend. Radio broadcasting stations are also giving a hand by broadcasting more interesting programs than ever, having the benefit of a year or more of experience to guide them.

Radio-Frequency Transformers.—Many dealers and consumers fear that present radio apparatus will become obsolete soon on account of changes in radio. However, consideration should be given to the development of other means of communication before passing judgment. The same basic principles still apply to the land telephone and telegraph. Refinements and additions have come, but the old apparatus still works. In radio the changes from now on are not apt to be basic ones. No doubt our present vacuum tube equipment will continue in use, although there will be numerous minor changes which will tend to make it far more efficient and satisfactory. One of these changes is radio-frequency amplification. The demand for greater reception range and the use of loop antennae require weak signals to be amplified to a greater degree. Additional stages of audio-frequency amplification are prohibitive on account of howling produced by the amplifying tubes and wiring acting as wave generators. By using radio-frequency transformers, however, the weak incoming radio energy may be amplified before reaching the detector tube, after which audio-frequency can be employed for loudness. Fortunately, several excellent types of radio-frequency transformers have now appeared on the market, and without extensive changes most of the existing equipment on the market can be altered for radio-frequency amplification.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Oil-Burning Lighter

To the Editor of the SCIENTIFIC AMERICAN:

We refer to the description of our lighter, which appeared in the June issue of your very valuable and highly appreciated magazine, and we wish to invite your attention to a later development in regard to the comparative cost of fuels for the steam lighter, and the Diesel engine-driven lighter.

In the article in question, the cost of coal for the steam lighter over a period of one month's operation is given as $410 and the cost of fuel oil for the new lighter for the same length of time is given as $250. This latter figure was obtained while operating with fuel oil and purchased by us for delivery in barrels at the shipyard where the vessel was constructed, and for which we paid 15 cents per gallon. All the oil obtained since this supply was used up, we have purchased at the fueling stations in the vicinity of New York harbor; and we have paid only 4 cents per gallon for this fuel. This means that the figure of $250 as quoted in your article can be reduced to $67.

We have kept a very careful record of the fuel consumption under constantly varying conditions of operation and we find the figures given above to be quite accurate, so that for an average monthly comparison, the fuel cost becomes $410 for the steam lighter, and $67 for the Diesel engine-driven lighter.

There is such a marked economy that we feel you would be interested in amending the figures, as first obtained and as printed in the article in your magazine.

New York. LOUIS R. FORD.

Can Change of Proportions Ever Constitute Invention?

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN, in a recent editorial under the above title, published the erroneous statement that in the patent litigation commonly known as the Minerals Separation case "the United States Supreme Court sustained a patent for a method which differed from a prior and long-used method only in that there was employed in the process an amount of oil specifically less than one per cent." The fact is that the long-used method of the prior art employed a ton of oil to a ton of ore and floated the metalliferous mineral particles by the buoyancy of masses of oil in which the mineral particles were entrapped, whereas the new process used an amount of oil which was a fraction of one per cent. on the ore (as contrasted with 100 per cent) and floated the mineral in a froth of mineral-coated bubbles by the buoyancy of the air in the bubbles. Further the art had abandoned this oil-buoyancy flotation method and was developing a metal-sinking process wherein the mineral particles were coated with oil (about 2 per cent on the ore) to make them adhesive and were rolled up, by agitating the pulp, into conglomerates which sank more reliably than the individual particles would have done, and it was in the investigation of the effect of reducing the amount of oil in this metal-sinking process that the new phenomenon was discovered of mineral-froth flotation with minute amounts of oil. Thus the discovery contradicted former experience and reversed the former procedure.

The obvious thing to do in the experiments in reducing the amount of oil in the metal-sinking process was to stop when it was found that the amount of oil had been so reduced that the particles would not stick together. But the inventors did not stop when the old process had disappeared, but continued to reduce the amount of oil and get nothing and to reduce and get nothing until suddenly came the new process, with its rich thick froth of separated mineral particles. There is no better example in the history of inventions of a reduction in the amount of one constituent producing wholly new and unexpected results. That the new invention was of incalculable value to the world and that it has revolutionized the concentration of ores were, of course, considered by the Supreme Court, but that it satisfied every requisite of an inventive act cannot be denied.

The alloy case principally referred to in your article was one wherein it was proved by the defendant and not denied that no new and advantageous result had flowed from what was in fact a mere change of proportions in mixing metals. The judge who wrote the opinion had also written one of the opinions sustaining the Minerals Separation patent, and he referred to this earlier opinion written by him as giving an example of new and unexpected results flowing from new proportions.

New York. HENRY D. WILLIAMS.

A Horticultural Hint

To the Editor of the SCIENTIFIC AMERICAN:

The ordinary palms and ferns for house use in the city, soon die. I believe this to be largely because of the soot in the air which contains sulfur compounds. I find that by mixing a teaspoonful of "drop chalk," also known as "prepared chalk," in two or three quarts of water and using this to water the plants, the bad effects are neutralized and the plants live indefinitely. Prepared chalk I find better than precipitated chalk. The composition is the same but the prepared chalk seems to contain some impurities of use to the plant. Other alkaline compounds help, but it is hard to get the right proportions while with chalk it makes no difference.

New York. R. M. SMYTHE.

Another Giant's Causeway

To the Editor of the SCIENTIFIC AMERICAN:

I read with much interest an article in a recent issue of the SCIENTIFIC AMERICAN (of which I am a subscriber) about the Giant's Causeway. It is probably not generally known that there is another formation of exactly the same character in Burnie, Tasmania. It is to be regretted that the people here have not realized the value of this interesting formation, and have used thousands of tons of this hexagonal stone in the building of a large breakwater nearby. Half of the formation still remains, however, and the people are just beginning to realize that it is high time a stop was put to the ruthless blasting of this rare curiosity.

Burnie, Tasmania. ALFRED E. PINEL.

Packing Apples

To the Editor of the SCIENTIFIC AMERICAN:

We get an enormous quantity of American apples here and I often think it is a great pity that so many are bulged with squeezing in the barrels. Each bulge is a bad place that has to be cut away and those are the places where the apples start to rot.

I think I can see a practical way of obviating this, and if you will be kind enough to publish the idea perhaps some of your readers in the apple-growing districts will give it a trial. My idea is to pack the apples with any kind of grain suitable for poultry food or for feeding domestic animals, say wheat, corn, or oats.

The market people who sell the apples here would sell the grain just as readily and so would the green grocers, so there would be no waste, and when they ascertained the approximate quantity of packing material per barrel they would know how much to allow for it, and for the better condition of the apples.

For filling, I should suggest placing the barrel on a vibrating plate and letting this grain rain into it at a suitable rate from a nozzle above. As the apples were placed in, the grain would fill all the interstices. The barrels would have to be good or have any holes papered over inside.

HAROLD SMITH.

Bingley, York, England.

Unskilled Building Construction

To the Editor of the SCIENTIFIC AMERICAN:

Apropos of your editorial remarks regarding unskilful and inexperienced designing and construction, which were called forth by the theater disaster at Washington, I am reminded of a similar instance which came to my notice some time ago, but which was fortunately reconstructed before the otherwise inevitable accident occurred.

The building in question was a large two-story frame structure which had been taken over for occupancy by a military organization, and I, at that time in the Engineer Corps, was instructed to make some neces-

(*Continued on page 448*)

Radio Notes

Trans-Atlantic Broadcasting.—What is reported to be a successful attempt to bridge the Atlantic with a radio-phone talk was recently made by the WOR station of L. Bamberger & Sons of Newark, N. J. The person who spoke into the transmitter was Sir Thomas Lipton, who was in the United States at that time. The speech was sent out on the usual 400-meter wave length, since WOR is a Class B radio broadcaster. Considerably more power than usual was employed for this attempt. The speech of Sir Thomas Lipton, as well as a vocal selection, were picked up and heard in the Selfridge store in London.

Should Receivers Be Rated in Ohms?—The policy of selling headsets on the strength of their direct-current resistance is held to be wrong by many radio engineers. It is claimed that the average 2000-ohm headset is as sensitive, and in many instances even more so, than the receiver with a resistance of 4000 ohms. Radio receivers should be rated by their impedance. The impedance varies, of course, with the frequency of the current. One well-known headset manufacturer has taken as a standard 1000 cycles, and at this frequency his headsets have an impedance of 22,000 ohms. It has been found that this is the resistance of the average crystal or tube circuit. This in itself, however, does not guarantee the efficiency of a headset, since there are many other requirements and features that determine the operating efficiency and sensitiveness of the radio headset.

Stranded and Braided Antenna Cable is made of 16 flat strands of the highest grade copper, each three-sixty-fourths of an inch wide, braided into a hollow cable about one-half inch in circumference. This makes it twice the circumference of the ordinary antenna cable. It gives an unusually large conducting surface and consequently low "skin effect" at radio frequency, and thus greatly increases the receiving and sending range. Its flexibility makes it especially practical for portable antenna for the camper, as it can be wound on frames. It can be used with marked results for indoor loop antenna, as it can readily be draped from the picture molding. The writer of these lines has been using this stranded and braided antenna cable for some time with remarkable long-distance results, whereas the same receiving apparatus, with ordinary antenna wire, never gave such distances.

The American Radio Exposition, which is to be held at the Grand Central Palace in New York City during December 21 to 30, promises to mark a new era in radio expositions. There have been so many radio expositions and shows that we are quite frank in stating that we have lost track of the number. Someone informs us that there were over 60 radio shows, worthy of that title, during the current year. Like in so many other radio matters, there have been much too many radio shows. Now the American Radio Exposition has been planned with a great deal of thought. Other shows have been studied, their good points carefully noted and their faults recorded, while the opinions and advice of the radio editors and radio engineers have been sought by the management of this exposition. There will not be several dozen loud-speakers shrieking and groaning at the disgusted visitor; instead, there will be a single nameless loud-speaker in operation, handled by an expert, and at all times doing full justice to radio. Other details will be solved in much the same manner, as compared with the pandemonium which has characterized previous radio shows.

The Class B Broadcasting Stations.—The Department of Commerce has taken a definite step toward solving the problem of interference in radio broadcasting, by the establishment of a new group of broadcasting stations to be known as Class B. Stations in the new Class B will be licensed to broadcast at 400 meters and will be required to meet rigid requirements as regards technical details and programs. The thought behind the new classification is to form a group of powerful and well-conducted radio broadcasting stations which, being scattered throughout the country, and operating on a wave length which does not conflict with the great majority of broadcasters, will serve the public to the best advantage while not depriving local broadcasters of their present activities. On October 5 last there were 546 broadcasting stations, with one or more in every State, of which 535 operated on the usual 360-meter

wave length and 11 on the 400-meter wave length of the Class B schedule. California still leads with 66 stations, Ohio follows with 35, and New York takes third place with 30. New stations are being opened up day by day, so that these figures are only as of October 5.

Long-Distance Reception is becoming more and more common with the advent of cold weather. Whereas last winter and spring it would have been considered a remarkable feat to receive from a radio-telephone broadcasting station one thousand miles away, this is now a rather common occurrence. In large measure this long-distance work is due to the use of more power and better apparatus at the transmitting end, supplemented by better receiving sets and more intelligent handling at the receiving end. The usual regenerative receiving set is quite a complicated thing to handle, and it is only now, after many months of experience, that many novices are getting the most out of their apparatus. Stations which have figured largely in widespread long-distance work are the *Atlanta Journal* (WSB) at Atlanta, Ga., *The Detroit News* (WWJ), the Palmer School of Chiropractic (WOC) at Davenport, Ia., the Sweeney Automobile School, Kansas City, Westinghouse (KDKA) at Pittsburgh, Pa., and General Electric Company (WGY), Schenectady, N. Y. On several occasions the WOC broadcasting station has been received in New York by amateurs with a clarity that is truly remarkable.

Operating Tubes on Lighting Circuits.—The employment of a high-voltage dry battery or storage battery for the plate circuit and a storage battery for the filament circuit of the usual vacuum tube equipment has proved a serious drawback. Several years ago the French and the German radio engineers worked out schemes for operating vacuum tubes on commercial lighting circuits. Our own Bureau of Standards has been at work on the problem for some time back, and has recently published its findings. The *Journal* of the American Institute of Electrical Engineers describes a five-stage amplifier which operates satisfactorily on 60-cycle supply for both filaments and plates. This amplifier has three radio-frequency stages and two audio-frequency stages and uses a crystal detector. The interference from the 60-cycle supply is practically eliminated by balancing resistances, grid condensers and special grid leaks of comparatively low resistance, a telephone transformer in the output circuit and a crystal detector instead of an electron tube detector. The account gives circuit diagrams, the final complete circuits for the five stages being reproduced, and states the values of the condensers, resistances and inductances used.

Minerals as Radio Detectors.—The action of a crystal detector may be explained as follows, according to H. S. Roberts and L. H. Adams of the Carnegie Institution of Washington. The alternating currents induced by radio waves are of such high frequency that even if a telephone were produced whose diaphragm could vibrate in time with them, the sound resulting from this vibration would be so shrill as to be beyond the range of the human ear. In order that they may be made audible, the waves must either (1) be broken up into like groups or trains which follow one another at an audible frequency (radio telegraphy) or (2) so "modulated" that their amplitude varies in time with an audible vibration such as speech or music (radio telephony). In either case they remain high-frequency electromagnetic waves. In the receiving apparatus, the high-frequency —or radio frequency—electromotive force is impressed on a circuit whose function is to distort the alternating-current wave in such a way that more current flows in one direction than in the other. This distorted wave may now be thought of as the sum of a radio frequency alternating current and a direct current, of which only the direct current is capable of actuating the telephone receiver. The ideal detector would allow current to pass freely, but in only one direction. A detector is, then, merely an electrical rectifier, and although in actual practice the rectifying action is far more complete, yet a certain amount of direct current is produced; moreover, it is a *pulsating* direct current, and the final effect in the telephone circuit is an alternating current of comparatively low (audio) frequency. Therefore, as the amplitude of the original radio wave changes, the diaphragm of the telephone receiver vibrates and reproduces, more or less faithfully, the changes impressed on the radio waves at their source.

Chemistry Notes

The Bureau of Mines has been making a study of common tests for poisonous atmospheres in abandoned mine shafts. A report on this subject will be issued at a later date.

Flotation Investigations.—Cooperative work by the Bureau of Mines and the University of Idaho on the theory of flotation is in progress at Moscow, Idaho. Some very interesting facts on the adsorption of oil by minerals have been developed, which will be given later in a detailed paper on the subject.

Chemical Instruction in Demand.—To meet the demand for instruction in chemistry—the 85 students of 1908 have increased to 576, and many applicants have been turned away—Columbia University is planning a new building with a capacity at least equal to Havemeyer Hall, which at present inadequately houses the subdepartment of organic chemistry.

Japanese Paper Water Bags Durable.—A United States Government expert, who has been investigating the wonderful papers of Japan, reports that the Japanese make water bags of rice paper which are held to be more durable than similar articles of rubber. Between the layers of paper, which is soft and flexible, resin is used and the outside is covered with lacquer.

Fine Platinum Found in Philippines.—A Manila dispatch to the *Public Ledger* says: "Sixty-eight per cent platinum has been found in the Liaga mines, owned and operated by the corporation which is making a thorough survey to ascertain the extent of the deposits. Platinum is widespread in the Philippines, but heretofore the quantities discovered have not been sufficiently large to pay for development.

New Method of Killing Germs in Milk.—Experiments in sterilizing milk are being conducted at a large plant in Endicott, N. Y., with a view of discovering a method that will destroy typhoid and tuberculosis germs. They have used several billion human and bovine tuberculosis germs and 14,000 quarts of milk in their work. Dr. Charles E. North, director of the North Public Health Bureau of New York, is in charge of the experiments.

Chemical Investigations in Benzol.—The control of research in the extraction and utilization of benzol in England has been taken over by a joint committee formed by the National Benzol Association and the University of Leeds. "Benzol" is here used in the widest acceptation of the term, so that the activities of the Association cover carbonization and gasification processes, by-product coke-oven plants, and gas works, although they are at present chiefly concerned with the promotion of home production of light oil and motor spirit.

Sodium Compounds.—Regarded either in tons or in dollars the sodium compounds industry for 1920 made an excellent showing. New records were made by sodium bicarbonate, bisulphite, phosphate and borax. Sales in the United States were 9,899,448 short tons, $139,252,477, as compared with 9,1666,-581 tons and $118,836,347 for 1919, 9,997,310 tons and $134,594,154 in 1918, and 10,123,-322 tons and $130,694,458 in 1917. During 1920 there was active prospecting with discoveries of new deposits in various localities, and many important patents were issued.

Waste and Want.—A sharp warning was delivered to the country by C. H. McDowell, speaking before the Chicago section of the American Chemical Society. Unless we mend our methods in agriculture, 197,-000,000 is the ultimate population limit without lowering our standards of living, and the year 2000 will find us with a population much exceeding that. Our laxity is in significant contrast to Germany's shrewd management. With but one-fifteenth our land area, she was producing, before the war, 40 per cent more wheat, barley, rye, oats and potatoes, taken together, than we were. Within the last 30 years she increased her yield per capita from 15 to 29 bushels, while our increase was from 14 to 16 bushels. In wheat her yield per acre went from 19 to 30 bushels; ours, from 13 to 15 bushels. In brief, Germany shows an agricultural efficiency six times that of the United States. Mr. McDowell urged engineers and chemists to attack our problems seriously, the one to prevent erosion of the land and devastation of the forests, the other to conserve the fertility now wasting through our ditches, rivers and sewer pipes; otherwise degeneration of the race through restricted food supply looms threateningly before us.

A Square Deal for the Psychics

(Continued from page 389)

same way about condemning her from it.

There are the three obvious alternatives of fraud, hysteria, genuine mediumship; there are other and less obvious ones. However one may be predisposed toward any particular hypothesis, one can only say that the report fails either to establish this or to rule it out. It is our sole source of information; but it leaves us without adequate data to regulate a choice between the various possibilities. We emphasize this, because we do not wish by our condemnation of Mr. Black to be put in the position of endorsing Miss B or any other medium, or mediumship in general. Miss B appreciates this position; she asks us, not to endorse her, but to correct misstatements made about her. This we are happy to do. McKenzie *did not* condemn her; for what his endorsement is worth, he endorsed her, squarely.

We are not without disinterested support in our verdict on Mr. Black. Our good friend Dr. Walter Franklin Prince, of the American S. P. R. and a contributor to our columns, bears us out and adds a revelation of another of Mr. Black's weaknesses. We quote from a letter received from Dr. Prince:

"I have just read cursorily Mr. Black's article in your September issue. I find in it this sentence: 'It seems that when the psychic "scientist" wanders into the spirit realm he leaves behind him his keen critical mind, taking with him one child-like in its simplicity and a will to believe anything that he sees and whatever is told him.' Considering this and many like articles I am tempted to paraphrase this sentence thus: 'It seems that when the amateur "critic" wanders into the psychic realm he leaves behind him his keen critical mind, taking with him one opaque in its prepossession, and a will to disbelieve everything he sees and to misquote everything he reads.' I am in thorough agreement with him in his desire to expose all fraud and pretentious ignorance, but I believe in being fair, even were I dealing with the devil himself. I have never had any experiments with Miss Ada Besinnet, and have not even read through the report of her work with the British Psychic College. But a single glance therein suffices to show the unfairness of the treatment of that report, the sole source of Mr. Black's authority. [We omit the portion of Dr. Prince's letter that goes over the ground we have covered.] I know nothing about the facts as stated in the report, neither does Mr. Black, and comments upon his version are superfluous.

"I am not an advocate of the phenomena alleged by Baron von Schrenck-Notzing and Dr. Geley. I see difficulties in the way of accepting all they report, and difficulties in the way of rejecting it altogether. But the argument based upon different appearances and effects of the purported 'ectoplasm' is on a par with criticisms which might be made by one ignorant of the science of electricity. One observer, he might exclaim, describes flashes, another streaks, and another a blinding mass of light. One calls the light red, another white, and still another blue. One speaks of an electric ball, while others are silent about any such appearance. The sounds produced are described differently. We hear on the one hand of its passing through a solid bar of iron, and on the other that it could not pass through a thin sheet of soft rubber. And to persons absolutely unversed in the matter, electricity at this point would appear ridiculous. 'Ectoplasm' may be ridiculous, but it is not proved so by such arguments."

Dr. Prince shows in detail that Mr. Black has misrepresented the Home case much as he has that of Miss Besinnet. He then goes on to say:

"I read further in the article that 'ordinary rules of evidence are discarded, and new ones peculiar to spiritism are adopted.' Again and again I have noticed on the part of critics whose acquaintance with psychical research is not extensive, that ordinary rules of spelling are discarded, and new ones, peculiar to criticism of this sort, are adopted—in relation to proper names. I would know that Mr. Black's acquaintance with the literature of psychical research was not very profound from the multitude of errors of this sort which he perpetrates. Instead of Besinnet I find Bessinet six times; instead of Baron von Schrenck-Notzing I find Baron Schrenk-Notzing six times; instead of Carriere I find Cariere four times; instead of Einar Neilsen I find Einer Neilson twice; instead of McKenzie I find Mackenzie twice; instead of the Rev. William Stainton Moses I find the Rev. Stainton-Moses; instead of

Frederic W. H. Myers I find Frederick Myers; instead of Eglinton I find Eglington; instead of Daniel Dunglas Home I find Daniel Douglas Home; instead of Franek Kluski I find Franck Kluski; instead of Lord Orrery I find Lord Orrey. At this point one might suspect that an article which could contain so many errors in proper names easy of reference would not probably have sounded the very depths of the history and subject-matter of psychical research. I do not care whether the controverted phenomena are 'voted up or down,' but I do confess to interest in accuracy and square dealing."

We are able to check up, on Mr. Black's original manuscript, the majority of the errors of spelling cited by Dr. Prince. In every instance where we can make this check, the error is Mr. Black's and not our own or the compositor's. Also we are promised by Dr. Gradenwitz, our German correspondent, a statement of the reactions of Geley and Schrenck-Notzing to Mr. Black's remarks; and, by way of a preliminary, Dr. Gradenwitz quotes original documents showing that Mr. Black is no more correct regarding the details of Einar Neilsen's mediumship than he is in the cases of Home and Miss Besinnet, or of Eva C. (below).

Finally we may let speak Sir Arthur Conan Doyle. Lest it be inferred that this well-known spiritualist exhibits prejudice, we may point out that he specifically leaves open the religious significance of psychic phenomena, their cause even; and deals only with their objective reality. We quote such of his letter as we have space for:

"I have read Mr. Black's article deriding in turn every form of psychic phenomenon. The objective reality of these phenomena—apart from their religious significance on which there is wide difference of opinion—has been testified to after careful personal investigation by many of the greatest minds and most trained observers in the world. Among these are Charles Richet, Oliver Lodge, Caesar Lombroso, William Crookes, Russell Wallace, William Barrett, William James, James Hyslop, and so many other observers of the first class that I could fill a column with the names. I ask you, then, is it not really absurd that a gentleman who, however estimable, is unknown to fame and makes no claim to have ever made any personal research speaks with contempt of the labors of these great men?

"How any sane man can in these days deny the existence of ectoplasm, in the face of the reports of Madame Bisson and of Professor Schrenck-Notzing, is unthinkable to me. In the latter's book will be found pictures of this substance drawn from seven or eight different mediums of various countries. The idea that all these are fakes is surely too absurd to be entertained. I have put it on record how I myself have held this substance in my hand. Quite recently in London I again saw masses of it form, Frau Sibert being the medium. A number of other people were present on both occasions. How can all this negative talk by Mr. Black or anyone else affect positive testimony like that?"

Sir Arthur dwells at some length upon the Besinnet misrepresentation, and shows that the statement that in London Eva C. produced "nothing, neither heads, faces nor ectoplasm" is equally at variance with the sole sources of information available to Mr. Black. He then turns to an aspect of the matter on which we have already commented, saying:

"As to the face of the medium being used as a basis upon which a spirit face is built up, that is an old phenomenon which has been admitted by all experienced spiritualists. Where the conditions are very good, one hopes to get an independent materialization, as Miss B frequently does. On the occasion of the McKenzie test the medium was unwell with a bad cold and the power was therefore low. Under these conditions one gets what is called a transformation, where an ectoplasmic mask is formed over the face, or possibly where the face is used without ectoplasm, but molded into the desired shape. I have seen this lady's face quite clearly before me in the early stage of a seance, and later I and others have seen men's faces, baby faces, faces with blue, gray or brown eyes, two faces simultaneously, and other signs of complete materializations. But surely the time has come when the public will see how absurd and illogical are all these denials from those who were not present, and have had no personal experience, when they contradict the solemn assertion of honorable witnesses with no possible object in deception."

We earnestly hope, as a result of our

offer announced on page 389, that we shall at an early date have our own first-hand experience with competent mediums to draw upon for first-hand accounts of what happens, and what does not happen, under the exercise of the psychic powers. With being the innocent bystander over whose defenceless form the combatants wage their strife we are done; we shall carry no more statements by persons who have not witnessed the phenomena of which they speak. Whatever of vicarious comment is to be made on psychic subjects through our pages we shall hereafter make ourselves, secure that it will then be made to our own satisfaction, if to nobody's else.

City Street Dust and Infectious Diseases

IN A very interesting article in *Ecology* for January, 1922, Dr. J. W. Redway of the Meteorological Laboratory, Mt. Vernon, N. Y., says: Most of the microorganisms found in street dust are harmless. Some, like the colon bacilli, are in the class of "suspects," still others are disease-bearing and deadly. The colon bacillus is almost universal where animals are used in street traffic. It is intestinal in origin and is abundant in the fecal discharges dropped on streets. As a part of the content of city street dust colon bacilli do not indicate the presence of typhoid bacilli. Winslow and Kligler found the ratio of colon bacilli to other microorganisms somewhat greater than 1 to 1000; in one instance the number exceeded 60,000 per gram. Their number in indoor dust averaged about one-fourth that in out-of-door dust. In medical science they are ordinarily regarded as harmless, but at times they are virulent.

The streptococcus is sometimes found in the horse-dung content of street dust; but the greater part is a product of human carelessness, due to the habit of promiscuous expectoration. Streptococci in street dust, therefore, are presumably of buccal origin. In themselves they are not regarded as harmful. If they are of buccal origin, however, they indicate the probability of pathogenic microorganisms that infect the mouth.

Of the presence of tubercle bacilli in street dust there is no question. The research of many years, covering practically all the large cities of Europe and America, show that they are rarely absent. Although street dust moves normally from out of doors to indoors, it is probable that tubercle bacilli accumulate indoors and are carried out of doors. The statistics gathered by Winslow and Kligler show that, while only about 5 per cent of the microorganisms in the dust of non-infected localities are tubercle bacilli, in infected localities the proportion is five times as great. Still further, the same authors find that, while in non-infected localities only 8 per cent of the animal deaths from all causes is due to tuberculosis, in infected localities about one-third died from that disease. Again granting that such values apply only to the localities in which the tests were made, the results show conclusively that infection from dust is not only possible but that it may be certain. So far as Europe and the United States are concerned, tuberculosis is not only pandemic; it is always with us; and although the death rate has been lowered, the total number of deaths therefrom has increased during a period of 20 years. And a reason therefore is not hard to find. Even if all other sources of infection be eliminated, street dust is competent to keep the disease with us. In the spread of microorganisms by means of air currents, Dr. Winslow gives first place to the "March gale." One might add that, if the velocity of an air current is doubled its capacity as a carrier of loose dust increases sixty-four-fold. Even with this capacity it is doubtful if a brisk breeze puts anything over the street sweeper's rattan broom. Either one is fully competent to account for the persistence of tuberculosis.

When Perforated Paper Goes to Work

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with life and motion. In the well-known opera, "The Tales of Hoffman," one of the tales depicts as its central figure a life-sized automatic doll who plays the part of a young lady. Of course the doll is a real lady who walks about with jerky movements and interrupted song, just as one would expect a mechanical contrivance to act, even to getting out of order and almost falling over.

The SCIENTIFIC AMERICAN of December 20, 1917, presented a most interesting story of the making of a picture-play film in which the action involved dolls, and in which it was necessary to pose *each separate exposure* by moving the arms, legs, etc., of the dolls by hand. What was a job of many months in this way would have been absurdly simple with the use of the kinautograph.

Automatically operated small dolls or figures should have a field in show-window advertising. At the present time considerable advertising is done in this way, but the figures go through a few simple motions and repeat them over and over again every few seconds. With a record control it would be possible for them to go through a little performance lasting say ten or fifteeen minutes.

A machine which would automatically draw pictures should also prove an attraction in a show window. By using two carriages such as those of the cloth-cutting machine, but carrying around a pencil instead of a cloth-cutting tool, a machine can be constructed which will mysteriously draw pictures while the open-mouthed mob is looking on. Not only can pictures be drawn, but while wisely explaining to each other how very simple the whole thing is, the crowd can see words written which will tell them all about the thing advertised. A record of a few hundred feet could keep the machine going for hours.

Many attempts have been made to operate the phonograph in time with the motion picture film, producing talking pictures. None of these has been wholly successful. The motion-picture technique is now so well established and understood that the acceptance of the talking film by the audience is somewhat doubtful; but passing this point over, the kinautograph offers a solution so far as the mere keeping step between the projector and the phonograph is concerned. And there are many other arts in which the principle of the kinautograph can be applied. A beginning has been made in the control of motion by perforated records—a vast field is thereby opened up for inventive endeavor.

The Dry-Cleaning and Dyeing Industry

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of solvent to run the average-sized up-to-date cleaning plant.

Gasoline and benzol are used in cleaning much as water is used in laundering. The chemistry of water for specific industries is in most cases very well defined, however, while in the case of gasoline and benzol scientific study has been confined almost entirely to their use as motor fuel. Motor gasoline and benzol were used by the cleaner because no specifications for cleaning solvent were available. Motor gasoline will clean fabrics, but properties which are essential for a motor fuel make it uneconomical for cleaning purposes. The light fractions are necessary to facilitate the starting of a motor; but when present in a cleaning solvent, these mean loss because they evaporate the first time that it is used. The higher-boiling fractions of motor gasoline are objectionable because that part of the solvent is hard to remove from fabrics and imparts an objectionable odor. Unsaturated hydrocarbons, which are not objectionable when used in limited quantities in motor fuel, are troublesome in cleaning solvent because it is difficult to remove the imparted foreign odor. A study to determine the most practical limits was accordingly made and specifications for cleaners' naphtha were prepared. An investigation of the same nature was made in the case of benzol.

When specifications for a satisfactory solvent had been determined, it was another problem to ascertain the most practical and economical way to recover the solvent after it had been used for cleaning purposes. Used solvent contains soap, water, and finely divided solid matter. For the most part these substances exist in colloidal state, and the problem of recovering the solvent by chemical means is therefore a problem in colloid chemistry. Much work has been done on this problem and some promising results have been obtained. It must, however, be considered that solvent can be recovered by distillation in an efficient still for a fraction of a cent per gallon; for this imposes severe demands upon any chemical treatment that may be proposed.

Another subject in which the cleaner is much interested is dry-cleaning soap. There are on the market numerous brands, for the detergent properties of each of which there are made more or less elaborate claims. No one brand combines very many desirable properties; hence a cleaner must have in stock several brands of soap to clean the different classes of materials, or else make

additions of various chemicals to some particular brand of soap to adapt it to the varieties of cleaning at hand. This condition has been unsatisfactory. In one plant as many as eight different brands of soap were being used. After considerable experimenting, a formula for a dry-cleaning soap was devised which can be used for all classes of cleaning with better results than any soap on the market. This soap can be easily made from common chemicals in the cleaning plant at one-third to one-fourth the cost of the soaps on the market. By its use materials which formerly had to be wet-cleaned are now dry-cleaned in a more satisfactory manner than when they were wet-cleaned.

Another object which is of vital importance to the dry-cleaner is the prevention of static electrical discharges in the presence of the vapors of the inflammable solvents. Unless precautions are observed when certain fabrics are washed in gasoline or benzol, these electrical discharges take place and sparks may result. A washer usually contains about sixty gallons of gasoline or benzol and is in the same room with much larger quantities. Most of the fires start when a workman reaches into a washer which has been in operation, to remove the materials being cleaned. In addition to the usual ways of preventing static sparks by grounding the washers, draining the solvent from the washers before removing materials, humidifying the air in the room, etc., an effective preventive is to add some substance to the gasoline or benzol which makes it a conductor of electricity. Then, if the washers are grounded, the bath does not become charged. Magnesium oleate, when present in a very small percentage, makes gasoline or benzol a conductor and is added to the rinses for this purpose.

The bacterial action of dry-cleaning is a subject concerning which there was no information in the literature. As a part of the regular program outlined for the year's work, an investigation of the bacterial action of the process of dry-cleaning garments with solvent such as gasoline or benzol was made at the Mellon Institute of Industrial Research, in cooperation with the Department of Biology of the University of Pittsburgh. Pieces of cloth, one inch square, were inoculated from a culture of the common hay bacillus, and then allowed to dry at room temperature. A number of these unit pieces of cloth were attached to a garment at the beginning of the cleaning process. One was removed after the clothing had been centrifuged, another after treatment in the tumbler, and a third after the garment had been through the pressing machine. The determination of the number of bacteria present was then made and comparison made with the bacteria found present in the untreated sample. In one series of experiments, live steam was introduced into the tumbler for a period of five minutes.

These experiments revealed the fact that the efficiency of the method of cleaning was unusually high. The hay bacillus used to inoculate the test pieces of cloth for the first series of tests is one of the most hardy bacteria. It is quite conservative to say that conditions that will kill it will also kill any of the disease-causing bacteria. Its destruction in these tests was on a scale sufficient to indicate that pathogenic organisms, such as the tubercle bacillus, the bacillus of diphtheria, as well as typhoid fever, would undoubtedly be destroyed. These tests indicate that the dry-cleaning process has a very high and hygienically satisfactory bactericidal efficiency, as measured by the standards used in public health work for laundering, treating drinking water, milk and food products.

Several institutions now have courses in practical dry-cleaning. Notable among these are the University of North Carolina and Iowa State College. Due to the initiative of the Oklahoma State Association of Cleaners and Dyers, a short course in cleaning and dyeing is also being offered by the Oklahoma Agricultural and Mechanical College.

The New Conservation—I

(Continued from page 404)

for improving industrial relations. Something to think about, isn't it? The whole question resolves into a careful calculation of whether the individual worker gets more out of the job in particular, and life in general, by applying these suggestions to his efforts than he does by not doing so. The chances are much in his favor that he will if he believes in the New Conservation and does his part.

Owners of enterprises can assist largely in stabilizing production by endorsing standards of management, in industrial relations, and many other "best practices," and encouraging their adoption and use. And the public, and that means YOU and I, and EVERY ONE ELSE in our 110,000,000 population, can give this whole waste-eliminating effort a great send-off by showing greater interest, by accepting a more sensible distribution of demand throughout the year, by being less insistent on style changes and by developing a greater general community cooperation with industry.

Trade associations can help—in fact, many of them are now most actively engaged in efforts designed to benefit their members through changing that wasted 40 to 30 or even less.

The Government is not failing to live up to its obligation in the matter. Secretary Hoover, of the Department of Commerce, is doing very effective work in the development of a national statistical service, in promoting a nation-wide program of industrial standardization or simplification; and, further, broadening the foreign markets for American products.

But these measures are only mileposts on the road to greater prosperity and greater commercial prestige than this great nation of ours has hitherto enjoyed. Industry is coming to be viewed more and more as a service to humanity, and that conception calls for higher standards, broader ethics, and more liberal practice than custom has dictated in the past. The Department of Commerce seeks to become the true representative, and the worthy servant of American business in presenting that new vision of service to the world at large. It is encouraging, through trade associations, and other groups, those higher ideals which make that Government best which governs least.

And out of this concerted action by engineers, employers, employees, owners and our Government, will come, if each of us does our part effectively, a more stable national equilibrium, and a consequently greater measure of enjoyment for each individual. We Americans like to believe we lead the world in many things. It would indeed be a sad awakening if we ever should see that day when, through our lack of appreciation of the real menace to our future as a nation that lies in unrestricted waste, our position is reversed, and we're no longer at the head of the procession. Our security is in our ability to get action when action counts most.

So let us practice the New Conservation!

Forgery or Genuine

(Continued from page 404)

tersections took place at a mean of 3.5 centimeters, and in the suspected document at over 8 centimeters, and it was considered that such a great divergence made it impossible to believe that both texts were written by the same person.

When the document is submitted to an expert, the first question is to find out whether a forgery was made by the tracing method. An examination is made by the microscope and by photomicrography, and this will show any retouches or going over the work. In some cases it will even be possible to prove that tracing has been used, by reason of a too great exactness. In the case of a certain will which was under test, a microscopic examination made at the Lyons laboratory showed a great number of retouches, but what was practically striking was—as shown in our figure—that certain words which were often repeated came from a common tracing, as is shown by the fact that they match in an altogether too regular manner. Micro-photography can be applied to make other very valuable tests. We illustrate one case which reveals certain characteristics which it would be difficult to put in evidence in any other way. For instance, certain writers have a tendency to make lines from right to left. This is nothing unusual when we have to do with lower loops or capitals, but it has the greatest significance when the writer makes an *o* in the clockwise sense, contrary to the usual practice. The present case relates to an *0* (zero) made upon a check. Another case is where the original employs the lower stem ending in a small hook which is turned to the right (see figure), while in the forgery the person turned the hooks to the left, according to his habit. This is one case in which micro-photography proved very valuable aid, for in this way a check paid by one of the leading banks in Paris for 95,000 francs was proved to be a forgery.

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Lack of space makes it impossible to give many cross-references, or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case the general subject should be sought, rather than the supposed specific title of an article; the article may not be indexed under its specific title at all, but may be entered under a statement of what it is about, so that it may the more readily be found by one seeking references to its subject matter. We call special attention to the classifications "Household Appliances," "Machines and Machine Tools," "Machines for Special Purposes," "Tools," etc., under which many items will be found whose location otherwise would be very puzzling. These groups may be examined item by item for a doubtful entry with much greater ease than can the entire alphabet. The individual articles on the chemistry and motor truck pages are indexed separately; the short notes comprising the columns of text on the advertising pages appear only under their column headings. The asterisk (*) indicates that the article in question is illustrated.

Unskilled Building Construction

(*Continued from page 439*)

sary alterations. The upper portion of this building was largely one big room, which had been used as a dance hall, with a clear span from wall to wall, a distance of 36 feet. This portion of the building had a projection of three feet over the lower story, and one of the first things noticed in the preliminary examination was a serious sagging at the wall which overhung, with a corresponding bowing up in the center of the dancing floor. As it was intended to use this room for instruction of squads of soldiers and considerable strength was required, the cause of the sag noticed was looked into and an astounding condition of affairs revealed.

It then appeared that the building had originally been of one story only, and as far as could be ascertained had been cut in half and the half containing the ballroom had been raised and placed on top of the remaining portion. The roof of the lower portion had not been removed and the ballroom was supported simply and only on a few short pieces of 2 by 4, wedged up from the old tin roof without any regard to the presence or otherwise of underpinning. A 2 by 4 plate was run around under the walls except on the overhanging side where the floor joists were cantilevered for three feet, carrying the wall and roof on that side, thus causing the sag and bellying of the floor. The plate was carried by short studs set on the old work, and there were no continuous studs and no sway bracing of any kind.

There was a large oriel window at one corner of the ballroom and the floor at this point had sagged as much as five inches from its true level, while the floor in the center was from two to three inches high, above normal. Reconstruction was immediately commenced, but with considerable anxiety for the safety of the men engaged, as for some time a collapse seemed imminent, due to the necessity of making cuttings to enter the new timbers. No accidents occurred, however, and a peculiar feature of the job was that hardly any of the supports removed to make way for the new work were found to be under any heavy compression, and it seems probable that the weight had been largely concentrated at a few points along the walls and especially at the corners.

It will always remain a mystery, however, as to why the building did not collapse long before, as it had been in the condition in which it was found for at least several years, and had been in actual use as a dance hall. Nothing is known regarding the builder or "designer" responsible for the condition found, but this, with other cases similar, is a strong argument for a different type of training both for the master builders and building engineers, in which a course of years under the tutelage of soundly experienced men in the trade should be an essential requisite for the issue of a license. Something might well be done also, towards improving the building inspection service maintained by practically all cities. If this were done, very few of these jerry constructions which constitute a constant hidden menace to life, would get by.

Victoria, B. C. J. B. HOLDCROFT.

The Steam Automobile

To the Editor of the SCIENTIFIC AMERICAN:

You published a letter from me nearly two years ago on this subject. Right now more interest is being shown in these machines than has been the case for a long time, so that a few words on what I consider a very important point may not be out of place.

Manufacturers and owners of steam automobiles have always made a feature of the absence of gear shift and clutch on this type of car, but I want to carry the matter into the enemy's camp, so to speak, and point out the danger of the gear shift on gasoline cars.

For a number of years I have had a chance to watch traffic at one of the most dangerous street intersections outside the business district of Washington. In that time I have seen many accidents and many more close calls between all kinds of motor cars. What appears to be the cause of these accidents? The dislike of shifting gears and the consequent negotiation of dangerous corners and intersections at excessive speed. This applies to nearly all drivers, and the only wonder is that more people are not killed.

The average driver will do anything to avoid shifting gears. He will take a corner at a dangerous clip in order to get a run at a hill and will risk his car and his own life rather than change gears. With a steam car, the knowledge that you can stop dead or reduce speed at a mere crawl and speed up instantly without danger of stalling makes it second nature to negotiate a hill at a decent rate and approach a crossing with care. This one feature of a steam car is worth a good deal.

Unless we can educate drivers in this country to use the gear-shift, the way they do in Europe, in other words, in the way it must be used to permit safe driving, or better still, do away with it entirely, the gas car in the hands of most people will always be a dangerous vehicle.

In closing, let me warn would-be designers of steam cars. Don't put gas-car complications, such as multiple-speed transmission on a steam car to make it work like the more familiar type. The steamer has advantages all its own and also drawbacks peculiar to itself. The best thing to do will be to educate drivers to operate a car based on sound steam engineering practice, even if it differs in every way from a gas car, rather than to produce an outfit combining all the disadvantages of both types.

HUGH G. BOUTELL.

Washington, D. C.

Make This Test Now

If you don't know what Pepsodent does, send the coupon for a 10-day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

Then judge by what you see and feel how much this new way means to you and yours.

Men of Some 50 Nations

Have found a way to whiter, safer teeth

Look about you, wherever you may be. How many teeth now glisten—teeth which once were clouded.

It is so the world over. Millions of people use a new method of teeth cleaning, largely by dental advice.

If you don't know what that method means, you can learn in one week, if you will.

They combat the film

Dingy teeth and most tooth troubles are now traced to film. Film is that viscous coat you feel. It clings to teeth, enters crevices and stays.

Film becomes stained by food, tobacco, etc. Then it forms the basis of cloudy coats. Tartar is based on film. That's why teeth lose luster.

Film also ruins teeth. It holds food substance which ferments and forms acids. It holds the acids in contact with the teeth to cause decay. Millions of germs breed in it. They cause many serious troubles, local and internal.

New helps discovered

Tooth troubles were constantly increasing. They became almost universal. So dental science sought a film combatant.

Two methods were discovered. One acts to curdle film, one to remove it, without any harmful scouring.

Able authorities proved these methods effective. Then a new-type tooth paste was created, based on modern research. The name is Pepsodent. Those two great film combatants were embodied in it.

Leading dentists everywhere began to advise this method. Now careful people of some fifty nations employ it every day.

Two other new effects

Pepsodent also multiplies the alkalinity of the saliva. That is there to neutralize mouth acids, the cause of tooth decay.

It multiplies the starch digestant in the saliva. That is there to digest starch deposits on teeth which may otherwise ferment and form acids.

Those are Nature's great tooth-protecting agents in the mouth. Pepsodent, with every use, gives them manifold effect.

These results mean a new dental era. Those whiter teeth you everywhere see mean cleaner, safer teeth. The great tooth enemies are being fought in new and effective ways.

Every careful person should learn what this method means. The results are quickly seen and felt. A ten-day test will show.

Pepsodent PAT. OFF. REG. U. S.

The New-Day Dentifrice

Now advised by leading dentists the world over. All druggists supply the large tubes.

That Added Charm

Pepsodent means to women new beauty and new charm. With pearly teeth comes the desire to show them. Thus the open smiles you see everywhere now, in pictures and in persons.

To both men and women a ten-day test is a delightful revelation. The new protection it offers to children may have life-long effects. Dentists advise that Pepsodent be used from the time the first tooth appears.

Thus to every person in every home this method is important. You will know that when you see the results. Watch them for a few days, then decide. Cut out the coupon now.

10-Day Tube Free 1015

THE PEPSODENT COMPANY,
Dept. 464, 1104 S. Wabash Ave., Chicago, Ill.
Mail 10-day tube of Pepsodent to

.....

.....

ONLY ONE TUBE TO A FAMILY

Printed in the United States, by ANDREW H. KELLOGG CO.

"Red Baby"

The Nation's Service Truck

IF you could get a long-range bird's-eye view of this vast country of ours, the landscape would lie before you like a patchwork quilt of fields. From ocean to ocean the millions of fertile farms lie side by side, eternally growing foodstuffs for human beings.

See the many denser centers of activity, with smoke plumes rising everywhere like tufts on the patchwork quilt. These are the cities, the crowded places where live Manufacture and Commerce and Traffic. These thrive only when Agriculture smiles, for Agriculture mothers the world. Our nation's life grows up out of the soil—let no man forget that.

Agriculture smiles her best when Service is at her command. Her millions upon millions of farm machines must be kept at work. Her power equipment must not fail. Her methods must keep pace with the times.

Now, if you will look again, very closely down on the scene, you will see a far-flung network of service establishments for Agriculture. These are the farm machine headquarters of McCormick-Deering dealers, men who have a broad conception of service in business and who carry it right to the homes of their customers. Thousands of these dealers have equipped themselves with International Speed Trucks like the one pictured on this page—trucks which, because of their flaming red color, speed, and snappy lines, are popularly called "Red Babies."

This army of "Red Baby" Service Trucks is carrying service to the most distant farms, upholding the Harvester Company's ninety-year reputation as the chief servant of Agriculture in the invention and building of time and labor-saving machines and power equipment. These trucks are ever on the road, hurrying at the farmers' beck and call, distributing efficient equipment, information, and useful aid, carrying into all communities the methods that increase production and wealth—a service unsurpassed in any field of activity.

The "Red Baby" of the McCormick Deering dealer is working in the interest of every man, woman and child in the land. It is rightly named "The Nation's Service Truck."

INTERNATIONAL HARVESTER COMPANY

CHICAGO OF AMERICA (INCORPORATED) USA

93 Company Branches and 15,000 Dealers in the United States